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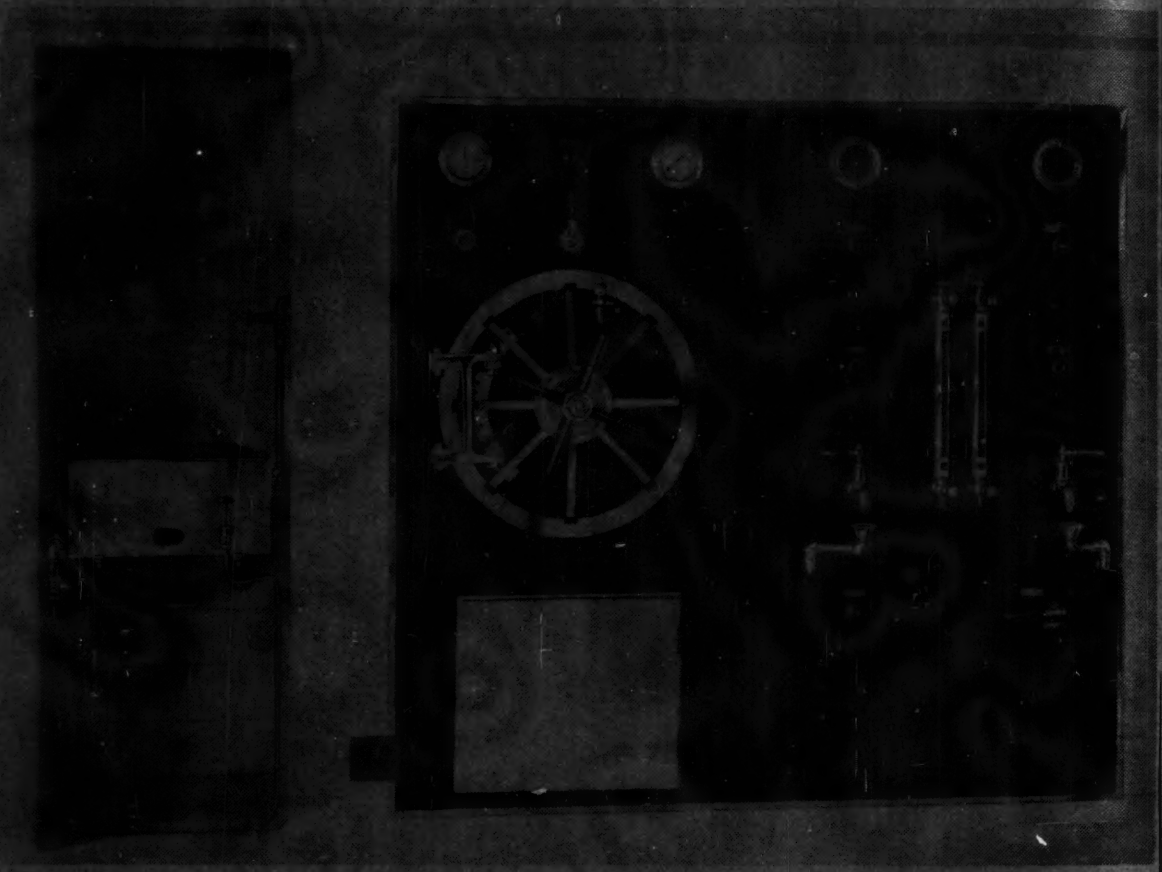

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A 'SLIDE' OPERATION FOR INGUINAL AND FEMORAL HERNIA

BY NORMAN C. TANNER
SENIOR RESIDENT SURGEON, ST. JAMES'S HOSPITAL, LONDON

EVERY year several new or modified procedures designed to cure inguinal and femoral hernia are described, and so it is with considerable diffidence that one introduces another. However, the very number of new operations described, as well as the recurrence rate—an average of 20–25 per cent and more for direct herniæ found after standard procedures[1, 2]—show that no completely satisfactory operations have been evolved for strengthening a weakened inguinal or crural canal.

The operation described below has the advantage of simplicity and ease of performance, it involves the introduction of no foreign material except a moderate number of sutures, it can be applied to the largest of direct inguinal herniæ, recurrent and strangulated herniæ, and over the course of two and a half years I have used it with advantage in 116 out of 148 inguinal and femoral herniæ treated by operation.

Briefly, the operation is a slide downwards and laterally of the lower rectus sheath and conjoint tendon (inguinal aponeurotic falx) to reinforce the posterior wall of the inguinal canal or to close the entrance to the crural canal, and so is a modification of the Bassini or of the Lotheisen operation.

It is, of course, not intended for every inguinal hernia, but is designed for direct inguinal hernia, except for that type resulting from a small localized defect in the transversalis fascia, and for the indirect inguinal hernia where a posterior repair is indicated, that is, in those cases of long standing where the widening of the internal inguinal ring (abdominal inguinal ring) and displacement of the inferior epigastric vessels medially simulate a direct hernia, and has passed the stage where one or two sutures in the transversalis fascia can restore a small and strong internal ring.

The operation makes a more certain union when used in the case of clean femoral herniæ, and can be used for all such.

The present methods of posterior repair are numerous, but many have grave disadvantages. The Bassini operation, now practically abandoned by most English and American operators, has defects which have been pointed out by Ogilvie[3] and others and which are obvious during its performance, especially if operating under local or light general anæsthesia. When suturing the conjoined tendon to the reflected part of Poupart's ligament (inguinal ligament) the muscle is pulled far out of the line of its fibres and of its action, and the sutures are under tension when tied. Sometimes the lower fibres of the internal oblique are absent or atrophied[4] and very little is found to suture. If the patient strains the two structures are strained apart, with the result that later on the muscle often tears, leaving defects at the site of the stitch holes, or the inner end of the conjoined tendon parts altogether from Poupart's ligament. Even should the sutures remain, the distorted muscle must fail to function and later atrophy.

Other operations have varying popularity. The turning over of a hinged flap of rectus sheath (Halsted, Wolfler) leaves a wide weak area lateral to the rectus; suturing the rectus muscle and sheath to Poupart's ligament (Bloodgood) grossly distorts the rectus muscle and it must later atrophy or tear away. Suturing one flap of the external oblique aponeurosis behind the cord—either the inner flap (Wyllys Andrews) or the outer flap (Zimmerman[5])—has many successes, but the external oblique is usually thinned and would not suffice for a severe defect. Suturing the whole external oblique behind the cord seems to me a bad operation, as it takes no account of the normal sphincteric mechanism of the inguinal canal and leaves a direct route for recurrence. P. Turner repairs the defect in an original fashion by bringing up a flap of deep fascia from the thigh.

Of later years darning the defect with free fascial sutures (McArthur, Gallie, and Le Mesurier) or with silk (Sampson-Handley, Souttar, Ogilvie, Maingot) have had a great measure of popularity. They give at best a layer of scar tissue, and the foreign material introduces a greater risk of sepsis. The operation may be rather prolonged—an important

factor only when dealing with feeble patients. A certain number have pain in the site from which the fascial graft is taken in the Gallie operation, though this never appears to be severe enough to keep them from work.[6]

A. K. Henry also uses free fascial strips in certain cases, but advocates a midline sub-umbilical extraperitoneal approach, and repairs the posterior wall of the inguinal canal and the internal abdominal ring from behind.

The late results of fascial suture are not entirely satisfactory, Burdick et al. report a recurrence rate of 29·1 per cent,[7] though Williams[5] reports a recurrence rate of only 8·3 per cent for direct herniæ in adult males. The former reports that sometimes the fascial sutures appear to be absorbed, for they may be absent when operating for recurrence. It is obviously impossible to give hard-and-fast recurrence rates for all these operations. The results for a specified method will depend on the operator as well as on the type of patient presenting himself for operation. No technique will give good results unless carefully applied, the suturing done gently and accurately, and full attention paid to asepsis and hæmostasis. There are also types of patient, as for example the obese vigorous male with a large hernia of long standing in whom the muscle and interfascial planes are extensively infiltrated with fat, whose chances of permanent cure are correspondingly less.

The advantages of the slide operation are as follows :—

1. No foreign material is used in the repair except for a moderate number of silk sutures.
2. By displacing the insertion of the lower fibres of the internal oblique these fibres approach and lie parallel to Poupart's ligament, so that when lightly sutured to it they neither atrophy nor tear.
3. The new posterior wall of the inguinal canal retains its full and undisturbed blood-supply.
4. The neighbouring structures are not appreciably weakened.
5. There is a minimal anatomical interference, and so the operation is rapid and safe.

THE 'SLIDE' OPERATION IN INGUINAL HERNIA

The operation may be done equally well under general, spinal, or a local anæsthesia. I prefer the latter when operating on the feeble or aged, or in the presence of strangulation.

The skin incision may be the usual one immediately over the inguinal canal, or it may be placed more transversely, making a lateral continuation of the lowest abdominal skin crease ('line of Venus'). The external oblique fibres are divided to expose the inguinal canal and cremaster muscle, with the ilio-inguinal nerve coursing over its surface. The cremaster is divided, the spermatic cord lifted out and a search made for a sac. Should an indirect sac be found it is opened, its contents returned, and the sac tied and removed at the level of the internal abdominal ring. The internal ring is examined to determine how much it is enlarged—if there be no enlargement anatomical restoration of the inguinal canal is made, if there is slight enlargement the ring is narrowed by suturing the transversalis fascia at the inner edge of the dilated ring to the reflected or recurved part of Poupart's ligament with fine silk sutures and the canal then restored to its normal anatomy. If the ring is much enlarged or distorted towards the pubis then the slide operation is done.

The wide-necked direct hernia is a further indication for the operation. There is usually no need to remove the peritoneal sac, but the stretched transversalis fascia is partially excised at its lower part, and the lower free edge of the upper part sutured to the reflected part of Poupart's ligament in order to restore a normal degree of tension and its supporting function.

A decision to do a fascial slide having been made, the superomedial leaf of the external oblique aponeurosis is elevated gently with a retractor, and dissected off the underlying internal oblique muscle, until the rectus sheath is exposed. The dissection is continued medially without difficulty, for in this situation—below the linea semicircularis (semilunar fold of Douglas) the aponeurosis of the external oblique muscle is only attached to the underlying fused aponeurosis of the internal oblique and transversus muscles by loose connective tissue—a point which is very easy to notice when performing a Battle incision. The dissection is effected by blunt dissection aided by a few careful strokes with the scalpel. Care is necessary to prevent damage to the ilio-hypogastric nerve, which may either be found leaving the internal oblique muscle lateral to the rectus sheath and coursing medially to perforate the external oblique, or it may be found passing straight forwards through the whole anterior rectus sheath. Damage to the nerve would cause a slight patch of anæsthesia of the lower abdominal wall. A small vessel often accompanies the nerve and may need a ligature.

This separation is continued medially to about the junction of the inner one-third with the lateral two-thirds of the rectus muscle, downwards to below the pubic crest, and above to a good hand's-breadth above the pubic crest.

Next a curved incision is made, through the fused aponeurosis of the internal oblique and transversus, commencing at or slightly below the level of the pubic crest and as far medially as the dissection will allow. This incision passes straight upwards, then curves outwards to end a hand's-breadth above the pubis and about 2 cm. medial to the lateral edge of the rectus abdominis muscle (*Fig.* 237)—again guarding against damage to the ilio-hypogastric nerve. As soon as this incision is made, there is a tendency for the lateral edge of the incision to slide downwards and laterally, especially if the patient strains. This sliding movement is assisted by catching

the lateral part of the rectus sheath with Allis forceps and exerting gentle traction downwards and laterally. It will be found that the slide is impeded by the insertion of the pyramidalis muscle to the sheath, but a few strokes with the scalpel between pyramidalis and rectus sheath will free the sheath and allow the slide to continue until the pyramidalis and rectus muscles are widely exposed. So long as the upper end of the incision did not approach too near to the lateral edge of the rectus muscle, there is no tendency for this edge to be exposed in the resulting spindle-shaped aperture in the rectus sheath, even on vigorous straining by the patient.

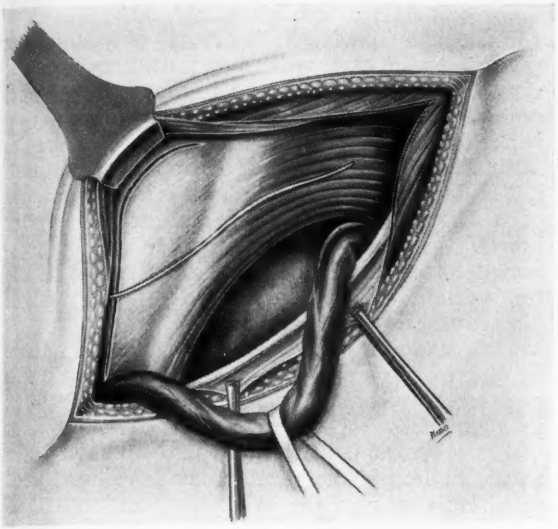

FIG. 237.—The external oblique muscle retracted. The incision is shown in the fused aponeuroses of the internal oblique and transversus muscles.

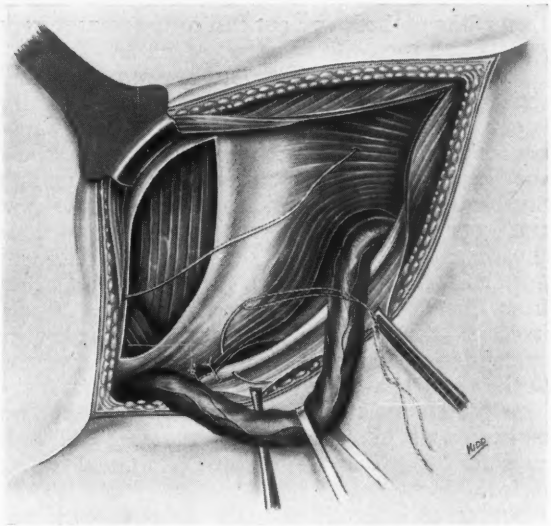

FIG. 238.—The slide completed and suturing commenced.

It will now be observed that the high arching fibres of the internal oblique (conjoint tendon) are flaccid and straight and tend to lie parallel to Poupart's ligament (*Fig.* 238). Even if the lower fibres of the internal oblique were deficient some muscle fibres will now be found close to Poupart's ligament.

Interrupted silk sutures are now placed so as to unite this tissue to the reflected part of Poupart's ligament after carefully cleaning away any fatty tissue from the structures to be united. The union is made from the pubic tubercle outwards, until only a narrow outlet is left for the spermatic cord, and the sutures are placed lightly so as to avoid strangulating the tissues. It will be noticed that the suturing does not involve pulling the muscle-fibres out of their new alinement, and so it does not split or distort the muscle. The medial end usually contains little or no muscle-fibres, and here the outer border of the lower rectus sheath has slid down and is easily united to Poupart's ligament with interrupted sutures. The suture material used is No. 4 or 5 Chinese twist silk, because a non-absorbable suture is advisable when suturing structures—muscle and ligament—which do not tend to unite very readily. Silk has the added advantage of having a more secure knot, of being easily sterilized, and statistically repair with silk sutures appears to produce a lower recurrence rate in hernia.[8]

Two variations in this suture may at times be adopted with advantage: In direct hernia, where the transversalis fascia is much stretched and the lower part has been excised, instead of suturing

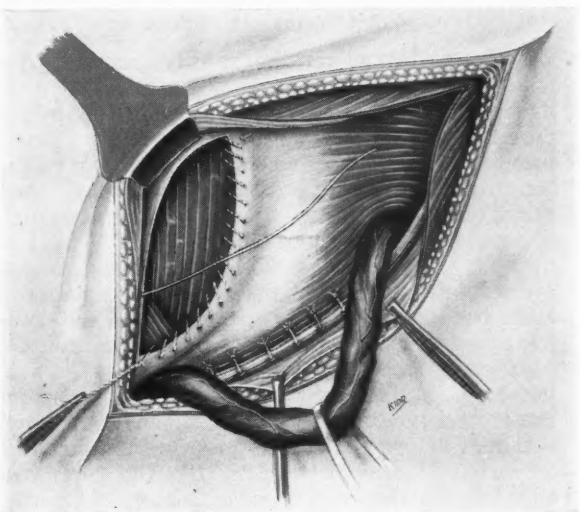

FIG. 239.—The slide and its fixation by sutures completed.

the transversalis fascia separately to the reflected part of Poupart's ligament, the posterior repair sutures may take first the 'down slid' conjoint tendon, then a bite of the lower cut end of the

transversalis fascia, and then the reflected part of Poupart's ligament. On the whole I consider this variation preferable, as two rows of sutures in the reflected part of Poupart's ligament tend to split it.

Another variation is to adopt Maingot's[9] suggestion of closing the crural canal when operating for direct inguinal hernia. In this case the sutures would take first the 'down slid' conjoint tendon, then a bite of the lower cut end of the transversalis fascia, and then the ligament of Astley Cooper.

Having completed the posterior repair to one's satisfaction, the cord is replaced. Next the superomedial flap of the external oblique aponeurosis is lifted up with a retractor to expose the bared rectus abdominis and pyramidalis muscles. A fine continuous silk suture is now run between the lateral cut edge in the rectus sheath and the adjacent rectus and pyramidalis muscle, taking wide but deep bites of the latter, from the lower to the uppermost edge of the incision—thus preventing any possibility of overslide—which may occur should the incision in the sheath have inadvertently gone too near the lateral edge of the rectus muscle (*Fig.* 239). I omitted this in all my earlier cases, but now consider it advisable as an additional safety factor.

A careful search is made to deal with any bleeding points, for any repair, however good, is jeopardized by hæmatoma formation or infection. The external oblique incision is then closed with continuous catgut anterior to the cord restoring the external ring (subcutaneous inguinal ring) to normal proportions. The deep fascia is closed with fine catgut, and the skin with clips.

THE 'SLIDE' OPERATION IN FEMORAL HERNIA

The operation can be readily modified for femoral hernia. The inguinal canal is opened, its posterior wall incised by division of the lowest part of the transversalis fascia, the hernial sac brought, after dissecting off its coverings, into the inguinal canal, and the sac opened and removed. The medial part of the external oblique aponeurosis is lifted and dissected medially, the same incision made in the fused aponeurosis of internal oblique and transversus as in the inguinal hernia operation, and the conjoint tendon made to slide downwards as before.

Closing the entrance to the crural canal, however, is effected by placing the sutures as in the second modification of the inguinal operation —that is to say, the suture goes through first the 'down slid' conjoint tendon, then the lower cut edge of the transversalis fascia, and finally the ligament of Astley Cooper, starting at the pubic spine and extending laterally as far as the femoral vein, but not so close as to compress it. Again the sutures should not strangulate the muscle-fibres or the rectus sheath aponeurosis, and the union can be made without the 'drum-like' tension often seen after the Lotheisen operation, though some of the muscle fibres are deflected somewhat out of their new alinement by the sutures. The operation is completed by closure of the external oblique aponeurosis, deep fascia, and skin.

CONTRA-INDICATIONS TO THE 'SLIDE' OPERATION

The chief contra-indication is of course met with in those cases where a posterior repair is unnecessary, as, for example, in cases of congenital oblique inguinal hernia where the internal ring is not dilated, or where it can be easily restored to normal by narrowing it with one or two silk sutures.

The second contra-indication is in the presence of a hernia containing infected or gangrenous bowel. In such cases the repair should be postponed to a second operation, or a repair of the transversalis fascia only made, using catgut instead of silk sutures.

Damage to the lower rectus sheath and muscle by previous operation—for example, suprapubic prostatectomy—may preclude the use of the slide; in such cases I perform a Wyllys Andrews or Gallie operation. Again, when operating for recurrent hernia the sheath may have been used as a flap repair in the original operation and so will not be available.

Age and poor health are not contra-indications to this operation in particular, as it can be performed rapidly and without shock. Large size again does not preclude the operation. I have never refused a hernia on account of its size, but have yet to find one so large that the slide would not repair it without tension.

RESULTS

I have been performing this operation for two and a half years and have in that time found it of use in 116 cases. It has been used on the very worst cases of direct hernia, many of them in bronchitic subjects—though of course whenever possible their operation was done in quiescent stage with non-inhalational anæsthesia. Thirty-eight of the cases were over the age of sixty, 42 of them were strangulated, 4 of them recurrent, and 20 of them were direct inguinal herniæ. Nearly all the inguinal herniæ on which I have not performed the operation in the last two and a half years have been small congenital herniæ.

It has proved impossible to present an adequate follow-up of these cases—so many of the ex-patients are in the army, on urgent Government work, or are evacuated from London. However, all have been asked to communicate with me after one year and at any time should they notice any recurrent swelling, and so far only one, an obese male, aged 57, with severe chronic bronchitis, and a bilateral direct hernia, has shown a recurrent slight bulge on one side after thirteen months. A second patient, treated by the slide operation for a wide-necked indirect inguinal hernia,

developed a femoral hernia on the same side fifteen months after operation. At operation on the femoral hernia the new posterior wall of the inguinal canal was found to be strong and intact and firmly united to the inguinal ligament. It was detached from the latter, and after removal of the femoral sac, sutured to Cooper's ligament. My excuse for presenting this operation without a follow-up is that, having found the operation so useful myself, I hope others will also find some value in it.

CONCLUSION

A description is given of a method of sliding the sheath of the rectus muscle downwards and laterally, in such a way that a repair of the posterior wall of the inguinal canal with living and functioning muscle is attained.

My thanks are due to Dr. W. Allen Daley, Medical Officer of Health, and Dr. Norman Craig, Medical Superintendent of St. James's Hospital, for their permission to publish this operation.

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A CASE OF ARTERIOVENOUS (CIRSOID) ANEURYSM OF THE SCALP SUCCESSFULLY TREATED BY COMBINED ARTERIAL LIGATION AND VENOUS INJECTION

By DAVID H. PATEY

SURGEON WITH CHARGE OF OUT-PATIENTS, MIDDLESEX HOSPITAL

A STUDY of the recent literature of the fairly rare condition of the scalp which is most commonly called cirsoid aneurysm, but which is also called aneurysm by anastomosis, plexiform or racemose aneurysm, and arterial angioma, reveals two main facts: the first, a growing recognition that the condition is a form of arteriovenous aneurysm (Reid, 1925); and the second, that the only sure means of cure is some form of direct attack. In particular, there is abundant evidence of the inefficiency of proximal arterial ligature as the sole means of treatment (Clunie). The most common form of direct attack has been excision of the whole mass, sometimes a formidable procedure in which in spite of all precautions there is a definite risk to life from hæmorrhage (Schlachetzki). Most of the relative surgical literature consists of reports of ingenious methods to prevent severe hæmorrhage during excision. Among such methods we find, besides proximal arterial ligature, the use of a scalp tourniquet (Kerr), preliminary cutting and compression of a scalp flap (Searby, Clunie, Rundle), and interlocking scalp sutures (Swinton). In the last few years, however, the possibility of a successful attack from the venous side in arteriovenous aneurysms has been considered and explored. Thus in 1935, Matas, during a discussion on the treatment of carotid-cavernous sinus aneurysms, stated that "the venous route by way of sclerogenic injections has not been sufficiently exploited in the modern sense"; and at the same meeting Reid discussed the possibility of sclerosing injections into the supra-orbital vein. In 1939 Singleton reported a case of carotid-cavernous sinus aneurysm which was apparently cured by venous injection after both extracranial and intracranial ligature of the carotid had failed. In 1937, Marshall reported 2 cases of cirsoid aneurysm, one of the scalp and the other of the lip, both of which were successfully treated by excision after a preliminary operation of arterial ligature and injection. He noted that at the excision of the cirsoid aneurysm of the scalp "there were no bleeding points which required ligaturing".

The case herewith reported is of interest from two points of view: In the first place, the arteriovenous nature of a typical so-called cirsoid aneurysm of the scalp is demonstrated by serial radiographs during intra-arterial injection of a radio-opaque solution; and secondly, the case has been cured by arterial ligature and venous injection without, as in Marshall's case, subsequent surgical excision.

CASE REPORT

HISTORY.—The case is that of a woman aged 43 years who came under my care in October, 1939. She was perfectly healthy and had no abnormality of the scalp until in 1905 when she was 9 years old she fell from a high step striking her head on to a concrete floor. The knock did not cause any breaking of the skin or external bleeding, but a small bump was raised on the back of the head. As the bump did not go down, a doctor was consulted who advised that it could be expected to disappear in a short time. As at the end of a few months no change had taken place, the child was taken to a children's hospital, where lotions were prescribed to be applied to the head. There was no improvement after six months of this treatment, at which time consultations took place with surgeons of a neighbouring general hospital. The child's parents were advised that the fall had caused a small hole in the skull; that any operation would be very critical, and that as the condition was not likely to cause any inconvenience or danger to life it was most undesirable to undertake any further treatment.

In 1914, the patient being now 18 years old, the lump on the back of the head became slightly larger, and a doctor was consulted, who referred the patient to another London general hospital. There, X-ray photographs were taken, and it was decided that if ever there had been a hole in the skull it had by then closed. For some weeks the lump was treated by hot fomentations without effect. After further consultations treatment was given by the insertion of an electric needle into the scalp adjacent to the lump. Two days after this treatment there was a short attack of bleeding which came in a very fine spurt from one of the puncture holes. Subsequently radium treatment was given, the radium being held to the head for a continuous period of one hour each week. This treatment was continued for a long time —the patient thinks for over a year—after which the head appeared to be practically normal.

During the years from 1915 to 1938, the lump reappeared and gradually increased in size. As it did not seriously inconvenience the patient she took no steps to obtain further treatment and lived a normal life. She married, but there were no children. Early in 1939 she consulted Dr. Maxwell Penny, of Penge, for some other complaint, and he, observing the by now large lump in the occipital region of the scalp with its large tortuous pulsating vessels, referred her back to the hospital at which she had previously had radium treatment. There, after deliberation and consultations it was decided to try the effect of further

radium treatment. But in the interval before her admission to hospital at the end of March, 1939, four brisk attacks of bleeding occurred from a thinned and unhealthy area of the scalp in the middle of the mass. In view of the changed situation, the surgeon in charge of the case advised that the case should now be treated by ligature of the main arteries in the scalp running to the mass rather than by radium. The patient, however, refused to submit to operation and left the hospital.

From April to October, 1939, the outstanding feature was the recurrence of the attacks of bleeding. Sharp attacks occurred in May, June, and August, and in the early part of October there were several attacks. The bleeding was controlled by firm pressure over the bleeding point on to the underlying skull, but in each attack the patient lost what appeared to be alarming amounts of blood. Her general condition, however, rapidly recovered between the attacks, but by the end of October, when the ulcerated area of the scalp in the centre of the mass had to be permanently compressed by a pad held in place by elastic strapping, Dr. Penny decided that the time has come when some measure of radical control of the bleeding was imperative. The patient now agreed to submit to any procedure necessary to accomplish this, and she was admitted to the Middlesex Hospital under my care.

EXAMINATION.—Generally the patient looked in good health, and showed no obvious upset from her repeated hæmorrhages. The occipital region of the scalp was occupied by a soft mass bulging above the general level of the scalp and extending well forwards into the right temporal region and slightly forwards into the left temporal region. The mass could be seen to be composed of tortuous blood-vessels up to the diameter of the little finger, the outlines of which were visible through the underlying skin and in which expansile pulsation synchronous with each heart-beat was prominent. Bleeding was found to have occurred from an area about $\frac{3}{4}$ in. in diameter in the centre of the mass over which the skin had ulcerated. There was necrotic tissue and discharge at the base of the ulcer, and the surrounding skin was thin and inflamed, the appearance suggesting that some local infection had taken place. This conclusion received confirmation from the temperature chart, which during the week before the operation during which the patient was undergoing investigation showed readings varying between 98° and 100·5° F. On palpation the mass was soft, fluctuant, and compressible, and its pulsatile character was again striking. A systolic thrill was palpable over a small area in the right temporal region and in the right occipital region. Auscultation in these areas revealed a continuous purring murmur with systolic exacerbations. Over the whole of the mass of the tumour auscultation revealed a systolic murmur. The patient herself was not worried by the pulsatile character of the mass, and experienced no feelings of throbbing or head noises. The arteries which could be palpated feeding the mass were the right and left temporals and the right occipital, but simultaneous pressure on all three vessels did not abolish expansile pulsation in the mass. Dilated veins could be seen as far forward as the frontal region of the scalp. The removal of the pressure pad over the ulcerated area for the purposes of the examination resulted in a recurrence of hæmorrhage, but this was immediately controlled by its re-application. Radiographs of the skull did not reveal any undue dilatation of diploic or meningeal vessels nor other abnormality of the skull.

OPERATION (Oct. 29, 1939).—During the course of induction of anæsthesia furious bleeding occurred in spite of the fact that the pressure pad and strapping had been left undisturbed. A further pad was applied and compressed by a length of circumferential strapping running right round the forehead and applied very firmly, and this controlled the bleeding. The patient's condition was temporarily very bad, and blood had to be given before it was thought safe to proceed, preliminary arrangements having been made in anticipation of this. The right external carotid was exposed, 10 c.c. of uroselectan B were injected into the artery, and a radiograph of the swelling on the scalp was taken by Dr. E. Samuel. This gave the picture reproduced in *Fig.* 240, in which the temporal and occipital arteries can be seen not obviously grossly dilated, and the main bulk of the mass is composed of large tortuous thinner-walled vessels. The right external carotid artery was now ligatured. The force of the pulsations in the mass was diminished by this procedure, but was still well marked. The left external carotid artery was next exposed and 10 c.c. of uroselectan B were similarly injected on this side. But on this side serial radiographs were taken in quick succession, the first shortly after the injection had started, another towards its end, and another a few seconds after the injection had finished. Pictures of the three phases are reproduced in *Fig.* 241, A, B, C. The left external carotid artery was now tied. Pulsation in the scalp swelling was now abolished, and after the sewing up of the wounds in the neck 10 c.c. of 5 per cent quinine and urethrane were injected into one of the large tortuous vessels of the scalp swelling, and the patient returned to bed.

FIG. 240.—Radiograph of scalp during injection of uroselectan into the right external carotid artery. The prominent temporal artery and some of the dilated tortuous veins constituting the main mass of the tumour are seen.

INTERPRETATION OF RADIOGRAPHS.—The serial radiographs taken after the injection of the left external carotid with uroselectan clearly show that the mass is an arteriovenous aneurysm, the main bulk of the mass being tortuous, dilated veins. Thus in *Fig.* 241, A the arteries only are filled, in *Fig.* 241, B the arteries and the veins, and in *Fig.* 241, C the arteries are emptying while the veins still contain some radio-opaque solution. It is not possible from these radiographs to determine the site of the arteriovenous communication or communications, but from the clinical examination on the evidence of the palpable thrill and the bruit on auscultation there would appear to have been two such communications, in the regions of the right

FIG. 241.—Serial radiographs taken during the course of injection of uroselectan into the left external carotid artery. A, At the beginning of the injection—two arteries alone filling; B, During the injection—veins as well as arteries now filling; C, Immediately after the injection—arteries now empty, veins only filled. These three radiographs, though technically inferior to that in *Fig.* 240, prove conclusively that the condition is an arteriovenous aneurysm, and that the bulk of the tumour is composed of dilated tortuous veins.

temporal and the right occipital. If these were the only two arteriovenous communications, there must have been free anastomosis between the arteries of each side of the scalp as evidenced both by the radiographs and by the failure of ligature of the right external carotid alone to abolish pulsation.

POST-OPERATIVE COURSE.—Apart from the initial severe hæmorrhage from which the patient rapidly recovered in response to drip transfusion, the patient was not upset by the operation and her general condition on the following day was satisfactory; by which time, too, thrombosis in the aneurysm was well marked. There was moderate œdema of the scalp, in part possibly an expression of the inflammatory reaction around the thrombosed vessels, but largely the result of the tight circumferential strapping applied to control the hæmorrhage, since it subsided when this was cut. Unfortunately this pressure caused some necrosis of the skin in the region of the forehead. There was evidence that bilateral ligation of the external carotid was not without effect on the nutrition of the corresponding vascular territory, since the patient developed a trismus due either to spasm or contracture of the masseters on each side which took several weeks to pass off; and her teeth which previous to the operation had been affected with pyorrhœa became looser so that many of them had to be removed and eventually a complete clearance was done. The post-operative course was also complicated by sepsis spreading from the original infected ulcer in the centre of the mass into the thrombosed veins, and for many weeks the patient was confined to bed with a temperature swinging at times up to 102°. This last complication would presumably have been avoided if operation had been carried out before the stage of ulceration.

RESULT.—I have recently seen this patient again at the end of July, 1941, twenty-one months after the operation. The arteriovenous aneurysm has completely disappeared, leaving as its only trace a small hairless region in the middle of the occipital region of the scalp corresponding to the area formerly ulcerated. There is no remaining disability referable to the tying of both external carotid arteries.

DISCUSSION

In this case a tumour of the scalp with the typical characters of an arterial angioma has been proved by serial radiographs after intravascular injection of a radio-opaque solution to be an arteriovenous aneurysm; the main mass of the tumour was composed of markedly dilated tortuous veins, and the arteries showed little, if any, dilatation. It does not follow from this that arterial angiomata do not exist, but it does lay the burden of positive proof on anyone wishing to make such a diagnosis. The arteriovenous conception of the aetiology does offer a comparatively simple mechanical explanation for this group of tumours in place of that of arterial neoplasia, which will not bear detailed analysis. This case, therefore, goes part of the way towards establishing the contention brought forward by Reid in 1925 that " cirsoid aneurysms and simple angiomata are caused by arteriovenous communications and are therefore not of the nature of new growths ". Sometimes the abnormal arteriovenous communications may be congenital;

sometimes, as in this case, traumatic. Whereas in other parts of the body the type of trauma leading to this lesion is usually a penetrating wound, in the region of the skull both intracranially and extracranially the injury is usually non-penetrating. Another peculiar feature of these arteriovenous aneurysms of the scalp is their progressive character as opposed to the tendency to stabilization often shown by similar lesions in other parts of the body. Congenital arteriovenous aneurysms of the limbs, however, often show a similar progressive tendency.

From the point of view of treatment, this case of an extracranial arteriovenous aneurysm may be set by the side of Singleton's case of intracranial arteriovenous aneurysm in that both appear to have been cured by a combination of arterial ligation and venous injection. It would suggest too that in Marshall's two cases which were treated by arterial ligation and injection as a preliminary to excision, the excision was unnecessary. The case also confirms that if necessary both external carotid arteries can be tied, but shows that this procedure may result in evidence of temporary vascular deficiency, so that it should only be carried out if less drastic procedures are inadequate. How far the method is capable of being extended to arteriovenous aneurysms of the limbs and elsewhere is a matter for speculation. But as a cautious form of exploration it might justifiably be tried in extensive congenital aneurysms in which amputation is being considered.

SUMMARY

A case of pulsatile vascular tumour of the scalp, commonly known as cirsoid aneurysm, is described. It is shown by serial radiographs during the course of intra-arterial injection of radio-opaque solution that the condition is one of arteriovenous aneurysm. The condition has been cured by a combination of arterial ligation and intravenous injection of sclerosing fluid. The literature shows that this combined method of treatment has already been successfully applied to carotid-cavernous sinus aneurysms, and it is suggested that the possibilities of the method might be cautiously explored in certain other arteriovenous aneurysms as an alternative to direct surgical attack.

I beg to acknowledge my indebtedness to my surgical colleague, Mr. P. B. Ashcroft, for his invaluable help in dealing with this case; to Dr. Eric Samuel for the X-ray investigations which settled the nature of the tumour; and to my former house surgeon, Mr. Whytehead.

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URETEROCELE, WITH PROLAPSE THROUGH THE EXTERNAL URINARY MEATUS

By IAN MACPHERSON

ASSISTANT SURGEON AT THE ROYAL HOSPITAL FOR SICK CHILDREN, THE VICTORIA INFIRMARY, AND THE ROYAL SAMARITAN HOSPITAL, GLASGOW

IN the light of present-day methods of examination slight ballooning of the ureteral orifices is no longer a rarity. It would seem worth while, however, to place on record some clinical and radiological observations on the more uncommon urological abnormality of ureterocele when it presents outside the external urinary meatus.

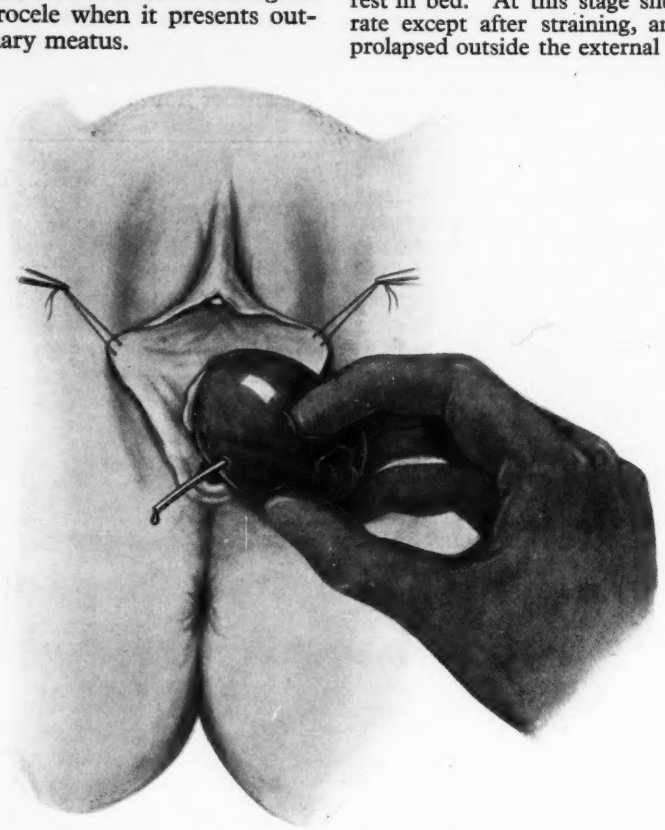

FIG. 242.—Shows the ureterocle prolapsed outside the external urinary meatus. Ulceration is present on its surface at the apex. The ureter has been catheterized from without the urethra, and indigo-carmine, previously injected intravenously, is being excreted.

CASE REPORT

HISTORY.—The patient was an unmarried woman, aged 27 years, who had enjoyed excellent health until the early part of 1940, when she developed a 'chill' in the bladder associated with frequency of micturition.

In January, 1940, she complained of a constant dull ache in the left lumbar region anteriorly, and in the left iliac fossa. The pain did not radiate, but it became more severe on exertion.

In February, 1940, she began to feel that the bladder could not be completely emptied, and that some obstruction was present which caused her to strain during the act of micturition. This straining brought a "lump" outside, which she said felt like a rubber balloon. She was forced to pass urine every half hour while on her feet, and two-hourly when at rest in bed. At this stage she was unable to micturate except after straining, and the ureterocele had prolapsed outside the external urinary meatus. After micturition she always attempted to push back the ureterocele by sitting on the edge of a chair and sliding along its margin. The prolapsed part became painful and irritable, and bled intermittently. Urinary incontinence was present when reduction of the ureterocele was not complete.

ON EXAMINATION.—When the labia were separated a bright red tumour was seen projecting through and beyond the external urethral orifice (*Fig.* 242). It had the appearance suggestive of a polyp. When distended with urine, it measured 2 in. in length by 1 in. in diameter, but could be extruded further by traction. The surface was congested, and the

degree of congestion depended upon the time it was prolapsed. The colour was at first similar to that of the bladder mucosa; later, it became bright red; and, later still, plum coloured. The surface showed slight ulceration, and was partly covered with fibrin. The tumour had a soft consistency, and could be emptied by pressure, the urine passing out in a fine continuous stream. This was a great help in determining the site of the ureteric orifice, which was situated to the medial side of the apex of the ureterocele. A metal bougie could be passed into the bladder alongside and around the cyst without meeting with any obstruction. The ureteric orifice was catheterized from without the urethra.

Reduction was simple; first, the sac was emptied and then pressed upwards and backwards against the external urethral orifice. The ureterocele then slipped back, with much the same feeling which is imparted in the reduction of a hernia. When the patient strained, the ureterocele could be prolapsed outside the external urinary meatus at will.

Cystoscopic Examination.—The urinary bladder held 10 oz. of fluid comfortably. Some slight trabeculation of the bladder wall was present, and a low-grade cystitis was evident towards the base of the bladder. Projecting from the left side of the trigone of the bladder was a large translucent cystic tumour, shaped like a pear, the base of which was continuous with the bladder mucosa, the apex floating free and traversing the base of the bladder from the left to right side (*see Fig.* 246). Towards the apex there was some congestion and ulceration of the mucous membrane, but the remainder of the outer wall of the cyst (and this was the greater part) appeared to consist of healthy mucosa, with fine vessels running from its base toward the free extremity.

The left ureteral orifice could not be identified owing to the bulk and shape of the ureterocele, nor could the right ureteral orifice be defined, even after attempting to displace the ureterocele with the cystoscope. It was only after the left ureterocele had been dealt with surgically that a ureterocele on the right side was first noticed. This projected straight out from the bladder wall. It had the size and shape of a large thimble. The mucosa covering it appeared to be normal, and at intervals a series of ripples passed along the wall of the cyst from its base towards the apex, filling it up and making it tense. It collapsed again following the evacuation of the urine from it, but this collapse was never complete, a projection always being present, but of a flaccid appearance.

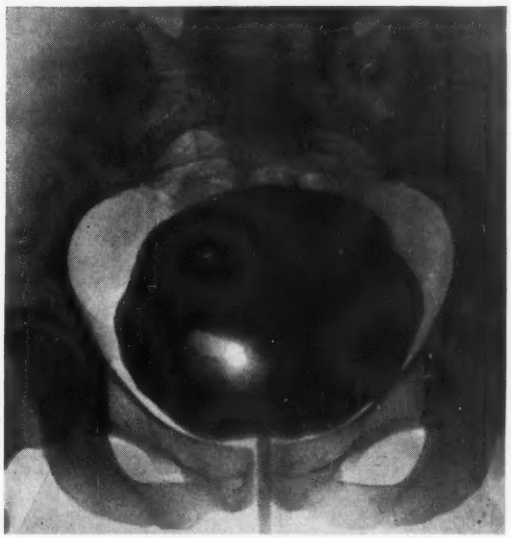

FIG. 243.—Cystogram, showing a filling defect in the bladder corresponding to the site of the large ureterocele.

Cystography.—The bladder was filled with 6 oz. of 12½ per cent sodium iodide solution. The film (*Fig.* 243) shows the bladder filled with the opaque solution, with a filling defect towards the base corresponding to the site of the large ureterocele lying within the bladder.

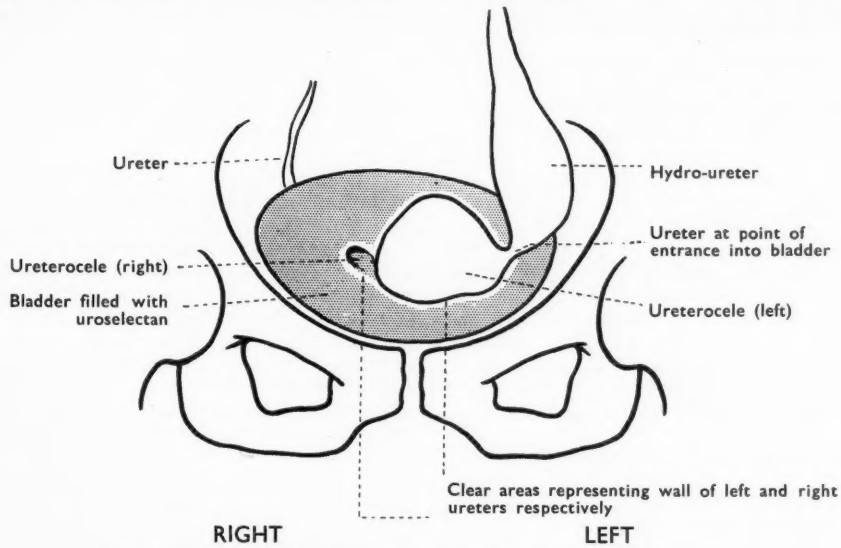

FIG. 244.—Diagram illustrating the findings on intravenous pyelography.

Pyelography.—

Intravenous Route: 20 c.c. of uroselectan B was injected intravenously, and a compression band was applied to the lower abdomen.

The *left* side shows a moderate degree of hydronephrosis, with clubbing of the minor calices,

Hydro-ureter is also present. The left ureter is not seen as it enters the bladder, but the space occupied by the left ureterocele is well outlined against the uroselectan which is filling the bladder.

The *right* side shows a normal renal pelvis and ureter. The ureter can be traced to the point where it enters the bladder. There it takes a sudden bend to the right, and becomes dilated to form a ureterocele, which is filled with uroselectan and is well outlined against the uroselectan which is already filling the bladder.

The bladder is shown filled with uroselectan. The left ureter is markedly dilated at its distal end, but is normal at the point where it enters the bladder. A continuation of the ureter within the bladder shows the ureterocele distended with the opaque medium.

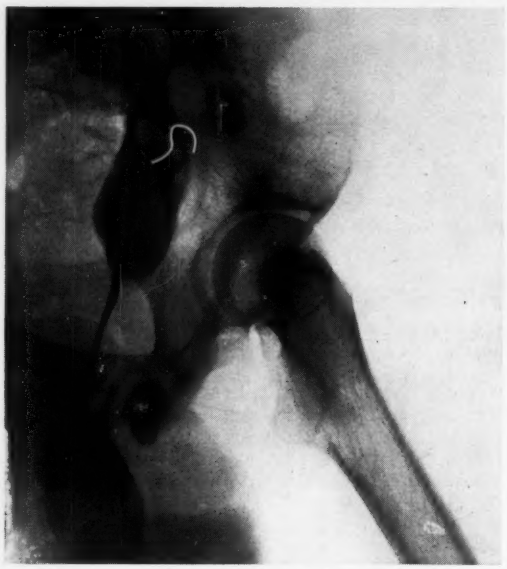

FIG. 245.—Retrograd epyelogram, oblique view, showing filling of the ureterocele lying outside the external urinary meatus, with the sodium iodide passing into the dilated lower end of the left ureter. The ureteral catheter is seen to be coiled upon itself.

The clear area between the opaque medium in the ureterocele and that in the bladder represents the thickened wall of the ureterocele. The right ureter, as it enters the bladder, appears to be normal, but one sees on this side a relatively small ureterocele filled with uroselectan, with a clear area around it (representing the wall of the ureterocele) against the contrast medium in the bladder. The diagram (*Fig.* 244) denotes the points illustrated in the film.

Retrograde Injection of Sodium Iodide (*Fig.* 245): The ureterocele has prolapsed outside the external urinary meatus, as in *Fig.* 242.

It was catheterized under direct vision from outside the external urinary meatus; 12½ per cent sodium iodide was injected through the ureteral catheter. The lower opaque shadow shows the ureterocele filled outside the external urinary meatus. The catheter is seen traversing the constricted neck of the ureterocele within the urethra, and entering the lower end of the left ureter, which is dilated and filled with sodium iodide. It will be observed that the catheter has coiled upon itself, and that it has passed downwards again through the upper part of the ureterocele through its narrow neck and onwards into the lower part of the ureterocele outside the vulva.

The left-sided ureterocele was emptied and reduced within the bladder, the ureteral catheter being left in situ. The ureteral orifice was so diminutive that it would not have been possible to find it, or pass a catheter through it via a cystoscope even if it had been found.

Sodium iodide, 12½ per cent, was again injected through the ureteral catheter. The pear-shaped appearance of the ureterocele is clearly shown filled with sodium iodide, the constriction of the lower end of the ureter, and the hydro-ureter (*Fig.* 246).

FIRST OPERATION.—Half an hour prior to operation morphia, gr. ¼, and scopolamine, gr. $\frac{1}{100}$, were administered. The patient was asked to micturate, and the ureterocele presented outside the external

FIG. 246.—Retrograde pyelogram, showing: (*a*) The ureterocele reduced within the bladder and again distended with sodium iodide; (*b*) The narrowing at the point where the ureter enters the bladder, together with a dilatation of the lower end of the left ureter.

urinary meatus. A very fine ureteric catheter inserted into the ureteric orifice was cut down on for a distance of 1½ in. with an electrode, using the diathermy cutting current, and the cyst laid open. A finger was then inserted into this wound in the ureterocele, as one inserts a finger into a hernial sac to put it on the stretch, and a circular section of tissue—the size of a five-shilling piece—was excised. All bleeding was arrested by the coagulating current before allowing the stump to retract within the bladder. A self-retaining catheter was then introduced into the bladder and connected to a bottle containing an antiseptic. The bladder was washed out with a 3·8 per cent solution of sodium citrate, and the following urinary antiseptic given four-hourly:—

Ammonium chloride	20 gr.
Hexamine	10 gr.
Liq. ext. of liquorice	25 min.
Water	to 2 drachms

The day following operation the pain in the left lumbar region had entirely disappeared. The urine was discoloured but no gross bleeding had occurred.

Cystoscopic Examination.—One week later cystoscopy showed that the inflated wall of the left

ureterocele had completely collapsed. Through a central opening, corresponding to the area excised at operation, the dilated lower end of the ureter could be seen at the point where it entered the bladder. The redundant wall of the ureterocele arose circularly around the ureteral orifice and was thrown into fairly firm puckered folds.

It was at this time that I was first able to view the right-sided ureterocele, which, until now, had been completely obscured by its fellow of the opposite side. The ureteric orifice was not visible.

SECOND OPERATION.—A diathermy electrode was passed through the cystoscope and the wall of the right ureterocele was split in a vertical direction by the cutting current throughout its whole length (*Fig.* 247). Bleeding was controlled by the coagulating current. The bladder was washed out and a self-retaining catheter was inserted. No anæsthetic was necessary.

FIG. 247.—Showing catheterization of the left ureter and the appearance of both ureteric orifices four weeks after operative interference. Both ureters are depicted on the same plate for convenience.

PROGRESS.—The patient was allowed home in ten days, and asked to report later for further examination.

On her return four weeks later, the patient was very well. The frequency of micturition had entirely disappeared. During the day she required to empty the bladder three or four times only, and she did not require to get up during the night. This is in marked contrast to the half-hourly frequency of micturition during the day and two-hourly during the night prior to operation. The flow of urine was quite free and there was no pain before, during, or at the end of micturition. She had complete control of the bladder even on exertion, whereas stress incontinence was a very troublesome feature previously. The pain in the left lumbar region disappeared the day following operation, and never returned.

Cystoscopic Examination (*Fig.* 247).—Both ureteric orifices were easily defined. The left one was situated near the centre of a slightly elevated circular area of healthy mucosa, with radiating puckers produced by the contraction and retraction of the redundant tissues. The right one could be seen at the base of a hood-like projection of an elevated translucent mucosa which had been slit vertically and had not contracted. There was no obstruction of either ureteral orifice, and the neighbouring bladder mucosa presented a normal appearance.

Intravenous Pyelography.—This showed that the right ureter was now a little more dilated than before, but no abnormality was visible in the bladder.

Histology of Tissue Excised.—Examination shows that the greater part of the ureterocele is lined by transitional epithelium which tends to be thrown into folds. In some places, however, this transitional epithelium is replaced by stratified squamous epithelium. Beneath the mucous membrane is a thick layer of connective tissue which is very vascular, and shows well-marked infiltration with lymphocytes and plasma cells. An occasional polymorphonuclear leucocyte is also seen. No muscle-fibres are present in the sections examined. The significance of this point will be referred to later.

Summary.—This case showed an extreme degree of ballooning of bilateral ureterocele. That of the left side was very large and had prolapsed outside the external urinary meatus. Since the ureterocele prolapsed through the external urinary meatus when the patient strained to pass urine when the bladder was full, it would seem inevitable that the bladder wall must have partially inverted at this time.

Owing to the stenosis of the orifice of the left ureter, renal drainage was interfered with, and there was an associated hydro-ureter and hydronephrosis.

The ureterocele of the right side was relatively much smaller in size, and, although the ureteric orifice was also stenosed, no abnormality of the right renal pelvis or ureter was evident on intravenous pyelography.

CONCLUSION

From the mode of onset and disappearance of the symptoms in this case, it would seem a moderately large ureterocele (as on the right side) can be present without causing any symptoms. The symptoms began suddenly and progressed without remission, and their onset would seem to date from the time the left ureterocele became large enough to reach the internal meatus and cause obstruction to micturition. They were all relieved by the removal of the obstruction in the left ureter.

Since there was no evidence of calculus on a straight radiograph, and there was bilateral stenosis of the ureteric orifice, the condition was most probably congenital in origin, although the symptoms did not occur until the second decade.

It is suggested that in this case the ureterocele does not represent a prolapse of the lower end of the ureter as a whole, but a prolapse and ballooning of its mucous lining only. The recesses depicted on each side of the left ureter at its point of entrance into the bladder (*Figs.* 244 and 246) show no evidence of the loosening up of the vesical mucous membrane as illustrated by Gutierrez[1] in his theoretical pathogenesis of ureterocele. The facts supporting this interpretation are: (*a*) The ureteric orifice is stenosed to such a degree that the ureter could not possibly slip through it; (*b*) The stenosed orifice remains the apex of the swelling; and (*c*) Microscopical examination of the wall

of the ureterocele shows that it contains no muscular tissue. The ureteric orifice has remained stenosed with the result that the mucous layer has been forced outwards into the bladder. There it becomes ballooned up into a cystic swelling. Hence the end-result is: (1) A stenosed ureteric orifice at the apex of the ureterocele; (2) A ballooned ureterocele in the bladder (and sometimes projecting beyond the external urinary meatus); (3) A hydro-ureter above this point. The points are shown in *Figs.* 242, 244, and 246.

The alteration in the type of mucous membrane lining the bladder from transitional to squamous epithelium was probably due to irritation when the ureterocele was prolapsed outside.

This case demonstrates the fact that in the female even a large ureterocele projecting outside the urinary meatus can be treated surgically either outside the urethra or transurethrally. It is suggested that this method is superior to operation by the suprapubic route in that: (*a*) It eliminates the need for general or spinal anæsthesia; (*b*) It entails a shorter stay in hospital; and (*c*) It is associated with less post-operative discomfort.

I would like to thank Dr. John Hewitt, Visiting Surgeon, The Royal Samaritan Hospital, Glasgow, to whom I am indebted for his helpful and kindly criticism, and also Dr. W. D. McCrorie, Dr. Scott Park, and Dr. W. G. Millar, for the trouble they took with the X-ray films and prints.

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TRAUMATIC CEREBROSPINAL RHINORRHŒA*

REPAIR OF THE FISTULA BY A TRANSFRONTAL INTRADURAL OPERATION

By KENNETH EDEN

FROM THE E.M.S. NEUROSURGICAL UNIT, HAYWARDS HEATH

With the accumulation of large numbers of head injuries in special Neurological Centres, the problem of the treatment of cerebrospinal rhinorrhœa caused by fractures involving the paranasal sinuses is likely to assume increasing importance.

Many different authorities have emphasized the danger of this type of injury. Teachenor (1927), for instance, examined the records of head injuries over a period of three years at one American hospital, and found 10 deaths due to spreading infection from fractures of the sinuses. Lawson (1934), in discussing post-traumatic cerebrospinal rhinorrhœa, went so far as to say: "These traumatic cases are always fatal in course of time from secondary meningitis unless the leakage is arrested by virtue of a healing process or by operative interference." More recently Cairns (1937) has pointed out that in the acute stage of head injury complicated by rhinorrhœa, surgical intervention is not essential to prevent intracranial infection and that many of these fistulæ heal spontaneously. In cases in which the rhinorrhœa is persistent or arises rather later, however, there is great danger of spreading infection from catarrhal conditions of the sinuses. Commenting on these cases, he stated: "The time has come for more active measures to repair the injured dura by means of transfrontal operation and sutures or fascial grafts."

Although opinion is still divided on the wisdom of early operation in all cases of fracture involving the paranasal sinuses and in cases of early post-traumatic cerebrospinal rhinorrhœa, there can be no doubt of the necessity of operative repair of persistent cerebrospinal nasal fistulæ. Moreover, in some of these cases there is the added complication of intracranial aerocele with progressive increase in intracranial pressure; this in itself provides a further argument for operative intervention.

It is true that relatively few successful operations have been recorded and the mortality of such an operation has been considered high. It is doubtful, however, if the risk is in any way comparable to that of withholding operation. Taylor (1934) estimated that 39 per cent of patients with cerebrospinal rhinorrhœa die unoperated upon, and that the operative mortality is about 30 per cent. It should, however, be possible nowadays with careful selection of the operation route, and the use of the sulphonamides, to reduce the mortality considerably below this level.

For these reasons it was decided at the outbreak of war to attempt operative repair of all persistent cerebrospinal nasal fistulæ which were encountered. The two following cases, one a bomb wound of the head and the other an ordinary civilian head injury, are the first results of this policy.

CASE REPORTS

Case 1.—

History.—A surgeon lieutenant, aged 24 years, received a penetrating injury of the skull while attending to the wounded on board a destroyer during an air attack. He did not remember the explosion and was unconscious for about twenty-four hours after the accident, by which time he was in hospital in this country, where two small wounds of the head were excised and sutured and multiple flesh wounds of the limbs were attended to.

Six weeks later the patient began to suffer from severe headaches and was admitted to Haywards Heath Neurosurgical Unit.

On Admission.—There were two small healed scalp wounds, one just above the inner end of the left eyebrow and one higher up in the right frontal region. The third left toe had been amputated and there were several large flesh wounds of the limbs still granulating. His sight was impaired by the opacity of multiple fragments of enamel paint in the cornea on each side. Mentally he was somewhat confused and retarded and complained of constant dull aching pain in the forehead, made worse by coughing. He stated that a week previously, when stooping forwards,

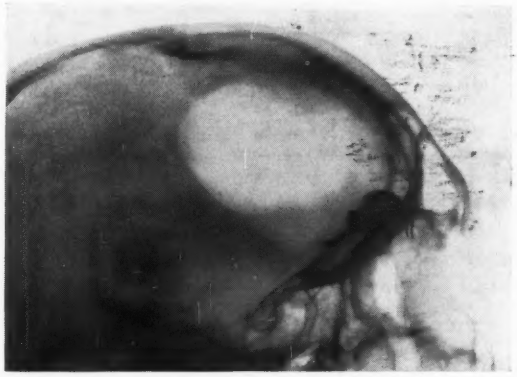

Fig. 248.—*Case* 1. Lateral radiograph of the skull showing the bomb splinter lodged in the back of the frontal sinus and the intracerebral aerocele.

* Being the substance of a paper read at the twenty-eighth meeting of the British Society of Neurological Surgeons.

he had felt a trickle of fluid down the left nostril; it was possible to reproduce this once again while he was in hospital.

Apart from left anosmia, there were no abnormal signs in the central nervous system. The pupils were equal and reacted to light and accommodation, ocular movements were full, the discs were normal, and there was no gross defect in the visual fields, though these were difficult to test owing to the foreign bodies in the corneæ.

puncture showed clear fluid at a pressure of 300 mm. of water which was found to contain 100 mg. of protein per cent and no cells.

OPERATION (April 16, 1940).—Operation was carried out under gas, oxygen, and ether anæsthesia with a continuous drip-blood transfusion (500 c.c.) after a 24-hours' course of M & B 693 (a total of 9 g.).

A left frontal pituitary osteoplastic flap was turned down (*Fig.* 249), exposing a tense dura. In order

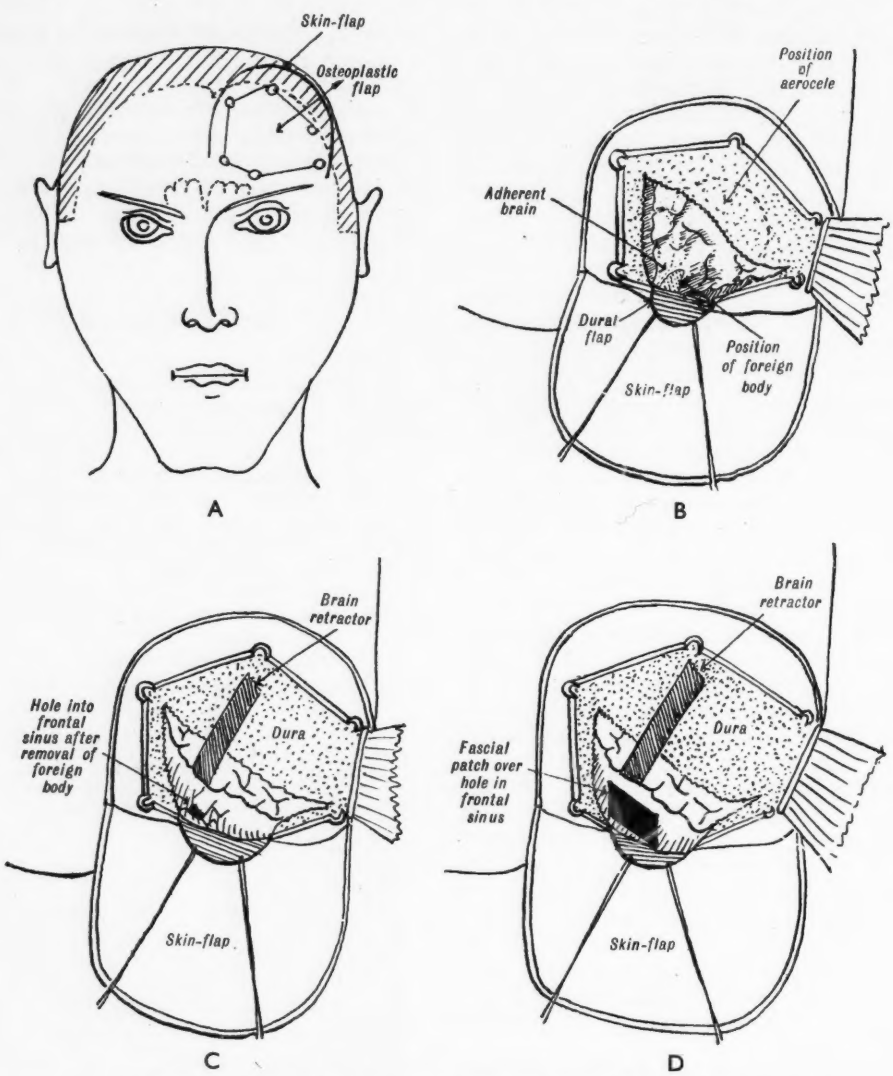

FIG. 249.—*Case* 1. Diagrammatic representation of the operation.

Stereoscopic radiographs of the skull showed a large fragment of metal (*Fig.* 248) lodged in the back of the left frontal sinus just above the cribriform plate. There was little splintering of the bone to be seen, but it was thought that the metal had entered above the left eyebrow. There was also a small depressed fracture corresponding to the wound in the right frontal region, but without signs of penetration. Arising from the region of the metallic fragment there was an aerocele apparently in the substance of the left frontal lobe, and this was seen to have enlarged in a second radiograph taken a week later. Lumbar

to reduce the pressure a small incision was made and the frontal lobe explored with a blunt cannula. At 3 cm. depth a cystic cavity was entered, a puff of gas escaped from the cannula, and at once the frontal lobe collapsed. It was then easy to open the dura and retract the left frontal lobe, separating a number of adhesions between its anterior pole and the posterior wall of the frontal sinus, until the foreign body was exposed. A sharp tug brought away the fragment of metal and left a gaping hole nearly a centimetre across into the frontal sinus. To fill this dural defect a patch of fascia lata, 3 cm., × 2 cm., was cut from the

thigh, laid over the defect, and made to adhere by continuous pressure for some minutes. The frontal lobe was then allowed to fall back into place and the osteoplastic flap replaced.

PROGRESS.—Convalescence was uneventful, and it was only when the patient was fully recovered from the operation that we were able to appreciate to the full the degree of mental retardation which had been present as a result of the aerocele. Eight months later he was in excellent health, back on duty in the navy, and none the worse for a number of catarrhal colds. There has been no opportunity to test his sense of smell, but he declares it to be normal. The metal fragment proved to be a piece of bomb casing and measured $1\frac{1}{2}$ cm. $\times \frac{3}{4}$ cm. It was sterile on culture.

Case 2.—

HISTORY.—A single woman aged 20 years was transferred to Haywards Heath Neurosurgical Unit on Sept. 26, 1940, ten days after she had been pitched over the handlebars of her bicycle when riding down a hill.

ON ADMISSION.—She was still confused and disorientated and tended to confabulate when a history was attempted. There was a stellate healed scar in the centre of the forehead, both eyes were surrounded by a resolving hæmatoma, and the left eye was slightly proptosed. No intracranial bruit was present. Examination of the nervous system showed that anosmia was complete on the right side and partial on the left. The pupils were equal and reacted to light and accommodation, the discs were normal, and the ocular movements and visual fields were full. There was some impairment of sensation in the distribution of the left supra-orbital nerve; elsewhere in the nervous system there were no abnormal signs except a left-sided analgesia which was thought to be hysterical in origin.

Stereoscopic radiographs of the skull (*Fig.* 250) showed a stellate fracture of the frontal bone extending into the frontal sinuses and up into the vault, on the left side to the region of the lambdoid suture. The roof of the orbit on the left was also splintered and displaced downwards.

The patient was treated by rest in bed and she improved steadily in general condition. Early in October she complained of a cold in the nose and during the next few days was observed to dab her nose frequently with her handkerchief. It was only, however, when on one occasion she was asked to bend forwards in order that her back could be examined, that fluid was actually seen to drip from both nostrils. Subsequently it was possible to produce the drip by jugular compression, and several cubic centimetres of clear yellow fluid was collected which resembled cerebrospinal fluid in composition.

OPERATION.—Operative repair of the fistula was decided upon and the operation was undertaken on Oct. 14, 1940 (*Fig.* 251). Using a frontal skin flap from ear to ear, a large left frontal osteoplastic flap extending well across the sagittal sinus was fashioned. Unfortunately a loose chip of bone from one fracture which plainly penetrated the frontal sinus was involved in the saw cut, and for fear of infection of the wound the operation was terminated at this point.

The second stage of the operation was carried out on Oct. 20, 1940. The skin and bone-flaps were again reflected and the dura opened each side of the sagittal sinus, which was ligated and turned upwards. In this way both frontal lobes could be retracted off the posterior walls of the frontal sinuses and the horizontal ethmoid plates. There was obvious splintering of the frontal bone on each side, but especially on the left side; several openings into the frontal sinuses were visible; the ethmoid plates appeared normal, although the cracks passed close to them. It was decided to attempt to cover the ethmoid plates as well as the back of both frontal sinuses, and a Y-shaped fascial patch was therefore cut from the thigh and laid in position so as to effect this. As in the previous case, pressure alone was used to secure adherence of the graft; the frontal lobes were then released and the osteoplastic flap replaced.

FIG. 250.—*Case* 2. Antero-posterior radiograph of the skull showing the splintered fracture of the frontal bone involving the paranasal sinuses.

PROGRESS.—Convalescence was marred by a troublesome infection of the bone plugs used to fill the trephine holes, but at no time was there any evidence of meningitis or of any further rhinorrhœa. The sulphonamides were purposely withheld prophylactically in this case as we wished to test the risk of infection in this type of operation.

The patient is now in good health except for occasional headaches of post-concussional type. There are no physical signs except persistent anosmia.

DISCUSSION

It is not proposed to describe here the mechanism of post-traumatic cerebrospinal rhinorrhœa and the formation of intracranial aeroceles, which has been discussed fully elsewhere (StClair Thomson, 1899; Dandy, 1926; Lewis, 1928; Cairns, 1937). It may be noted, however, that in both these cases the leak occurred into the frontal sinuses and not through the horizontal ethmoid plates. *Case* 2 was a typical example of a head-on road accident which Cairns has described as the type of injury liable to give rise to this complication. I have found no recorded cases of cerebrospinal rhinorrhœa due to perforating cranial injuries in the English literature, but there are a number in the continental literature at the time of the last war (Duken, 1915; Kredel, 1915).

It is interesting to note that in both these cases the rhinorrhœa did not occur until several weeks after the injury, when the patients were becoming actively convalescent; moreover, in neither case was it detected for several days after difficult in these cases. In *Case* 1, the left-sided rhinorrhœa and the left anosmia, together with the X-ray finding of a metallic fragment in the posterior wall of this frontal sinus and an aerocele in the left frontal lobe, clearly pointed to the site

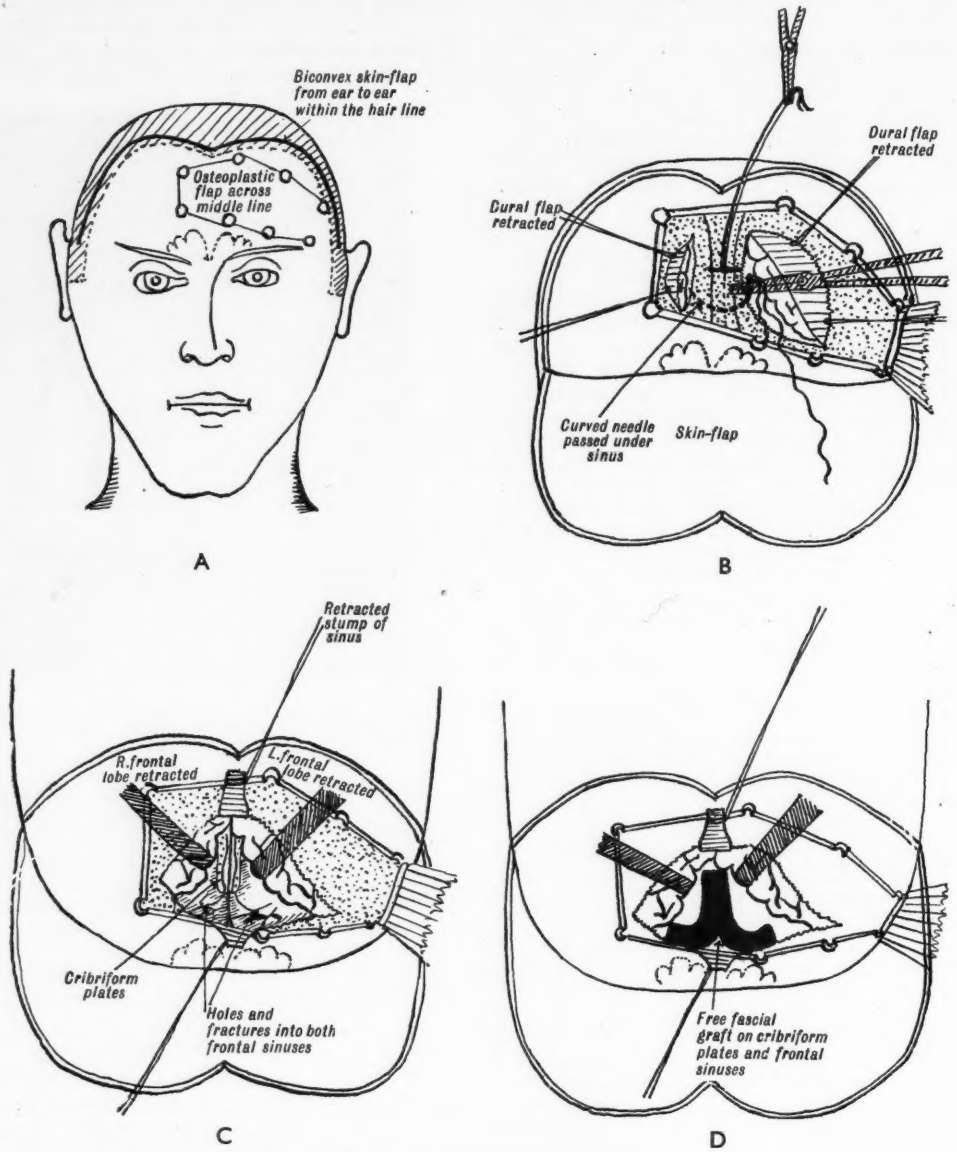

FIG. 251.—*Case* 2. Diagram of the operative approach.

its onset. Unless the possibility of cerebrospinal rhinorrhœa following fractures in the region of the paranasal sinuses is constantly borne in mind and these patients are questioned about 'running in the nose', or tested periodically by jugular compression during convalescence, it seems probable that this dangerous complication may be missed.

One of the reported difficulties of operating on cerebrospinal nasal fistulæ is the accurate localization of the leak, but this did not prove of the fistula. On the other hand, in *Case* 2 both the rhinorrhœa and the anosmia were bilateral and both frontal sinuses were shattered, which made it probable that there was a fistula into each sinus.

In deciding upon the operative route for the repair of these fistulæ, two main factors were taken into consideration—ease of access and the danger of infection. It was felt desirable to obtain as wide a view as possible of the damaged area of bone, at the same time avoiding the stirring

up of infection in the sinuses. The route suggested by Teachenor for repair of the dura after exposure and drainage of the affected sinus does not fulfil either of these conditions. The transfrontal extradural route which has been used successfully by Cairns (1937) and Gissaine and Rank (1940) suffers from the disadvantages that it may be difficult to expose the tear in the dura and if a fascial patch is found to be necessary, it must be laid directly on the wall of the sinus in the track of the fistula. We had in mind the previous experience of Taylor (1934) who closed a cerebrospinal fistula with a fascial patch laid between the dura and the sinus. In this case there was gross suppuration, the patch was reduced to a slough, and the patient succumbed to meningitis. For these reasons we chose the intradural route, using a similar technique to that employed for pituitary surgery for many years. The only other record of an attempt to repair a cerebrospinal nasal fistula by the intradural route seems to be that of Grant (1923) who abandoned the operation at an early stage owing to hæmorrhage, the fistula subsequently closing spontaneously.

This transfrontal intradural route gave an excellent exposure in both our cases. In *Case* 2 it was possible by ligating the anterior end of the sagittal sinus to expose both ethmoid plates and the posterior wall of the frontal sinuses, so that a large fascial patch could be placed right across the splintered anterior fossæ. The fractured sinuses were not disturbed by this operation and the free fascial patch was laid as far as possible from the seat of infection, thus reducing the danger of infection and sloughing of the graft to a minimum.

SUMMARY

1. Two cases of delayed post-operative cerebrospinal rhinorrhœa are described. In one case the fracture was due to the penetration of a bomb fragment which had lodged in the posterior wall of a frontal sinus and had caused an intracerebral aerocele. The other case was a head-on civilian road accident causing a stellate fracture of both frontal sinuses.

2. In both cases the rhinorrhœa was cured by the insertion of a fascial patch across the back of the frontal sinuses, using a transfrontal intradural operative approach. This route ensured adequate exposure of the damaged area and enabled the graft to be placed as far as possible from the potential source of infection.

In recording these cases I am indebted to Mr. Julian Taylor, who devised and carried out both operations.

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THE SKELETAL AND OTHER CHANGES FOUND IN A CASE OF SUPRASELLAR CYST OF RATHKE'S POUCH

By R. A. ROWLANDS, O.B.E., and S. L. SIMPSON

WITH A PATHOLOGICAL REPORT

By DOROTHY S. RUSSELL and H. M. TURNBULL

We believe the following case worthy of record because of the many interesting physiological problems bound up with its complex symptomatology; the long period of observation and investigation in hospital; and the complete necropsy findings. Unfortunately the extensive nature of the lesion and the involvement of adjacent areas by pressure constitute a severe limitation on any attempts at localization. The symptoms, however, are discussed in the light of more recent experimental and physiological evidence.

CASE REPORT

History.—The patient was a male, aged 43; admitted on Nov. 29, 1930, to the London Hospital, where he remained under observation until his death on May 16, 1931. His parents and five brothers and three sisters were all normal and healthy. Four children died in infancy. The patient's birth was uneventful and he appeared to be a normal healthy child. He was the first-born child. He stopped growing at the age of 12 and never developed any secondary sexual characteristics. His voice remained boyish and high-pitched, and he continued to sing in the church choir from boyhood until the age of 37. He never grew any hair on his face and never shaved. There was some evidence of a mother fixation, the patient stating that " I have only one sweetheart and that's my mother ". He never considered the idea of marriage and never sought female company. He had never had any erection or desire for coitus. Men and women were alike to him, and he stated that he considered the latter much as he would his own sisters.

His social qualities, however, were very well developed, he being secretary of numerous social, friendly, and sports societies. He himself played cricket and hockey. His mother stated that he possessed a very sympathetic and kindly nature, was very fond of children, and was popular and liked by everyone. His intellect was very good, and general knowledge relatively extensive, he being looked up to as the family encyclopædia. He earned his living as a storekeeper in an engineering works and gave every satisfaction at his work.

In general, the patient was a very useful and active self-supporting member of society until one year before admission to hospital. He then began to suffer from severe headaches in the frontal region, and lost interest in his work and his social activities. There was an indefinite history of similar headaches occurring over a period of twenty years, but not of sufficient intensity to disturb his work or leisure. The headaches now occurred two or three times a week, would last several hours and sometimes wake him at night. They commenced in the frontal region and spread over the vertex to the occiput. They were dull aching in character. About the same time (January, 1930), the patient tended to be very sleepy and was always willing to take to his bed. He was reluctant to go out in the evening and preferred to sleep. He also had attacks of momentary loss of consciousness, at which time his legs would give way under him and he would fall to the floor in a semi-stuperous condition. He would regain consciousness almost immediately, or within a few minutes. Sometimes he would be quite conscious throughout the attack, but quite unable to initiate the movement of getting up, and had to wait for someone to lift him. He often knew the attack was about to occur, and might have sufficient time to ring a bell in his works to summon aid. His frequent falls necessitated his giving up work in May, 1930. About this time he began to lose appetite and weight. He felt the cold very acutely, but had done so to a less extent for many years.

He had always been very thirsty and passed large quantities of urine. He invariably awoke during the night to pass water and the morning chamber was always completely full of urine. Urinary incontinence occurred occasionally, especially in attacks of somnolence (*see below*).

On Examination.—The patient was seen to be a wasted dwarf (height 4 ft. 5½ in., weight 4 st. 8½ lb.), with a wizard-like countenance, not unlike that seen in progeria. In some ways the expression was boyish, but the face was multilined with permanent furrows, and conversation was accompanied by much wrinkling of the forehead. This intermixture of youth and senility rendered an estimate of his age exceedingly difficult, although most observers inclined to assess the latter as somewhere in the second decade of life. The skin of the face was dry and thick, suggesting a myxœdematous condition, and completely devoid of any semblance of hair. The teeth were grossly carious and discoloured, with extensive periodontal suppuration, and the breath was fœtid. The tongue was clean and somewhat fissured. The skin over the trunk was very dry, but not particularly thick, and that over the fingers rather glossy. There was no sign of pubic or axillary hair. The genitals were infantile in character, the testicles being of the size of small peas and the penis constantly relaxed and 1½ in. in length (*Fig.* 252).

The relative proportion of the limbs and trunk did not appear abnormal; nor were there any obvious curvatures of the long bones or spine. The disorganization of the right hip-joint, which, according to the radiological evidence (*see below*) progressed

rapidly during the past few months, was undetected clinically; the patient was bedridden and resented examination of the lower limbs, which were held in the flexed position (*Fig.* 253). The muscular system was wasted and muscular power severely impaired. No rigidity was observed at the initial examination. All the reflexes were diminished and equal. The

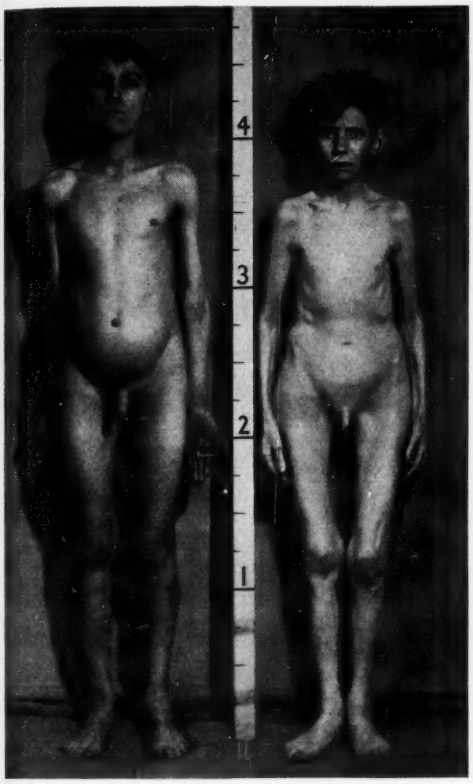

FIG. 252.—Photograph of patient, aged 43, on right, with a normal boy of 10 as a control.

fundi showed a bilateral primary optic atrophy. Lack of concentration prevented a detailed mapping out of the visual fields, but there was very definite curtailment of the temporal fields of vision on both sides, the right to a greater extent than the left.

The heart, lungs, and abdominal organs showed no abnormality. Systolic blood-pressure 105, diastolic 70 mm. Hg. The temperature varied between 97° and 98° C., the pulse between 50 and 70, the respiration 20.

Investigations.—

1. Basal metabolism was very considerably diminished, successive estimation (Dr. C. E. Brunton) giving measurements — 52·5 per cent, — 40 per cent, and — 52·4 per cent below the normal for a man of corresponding age, height, and weight (De Bois standard).

2. Sugar tolerance test: Fasting level 0·077 per cent; 50 g. glucose by mouth at 10.30 a.m.; 11.15 a.m. blood-sugar 0·05 per cent; 12.30 p.m., blood-sugar 0·087 per cent; no glycosuria was present throughout. The tolerance test indicated an increased carbohydrate tolerance. A further test was carried out to ascertain response to insulin. The blood-sugar two hours after 20 g. glucose by mouth was first ascertained, the average value for three estimations being 0·07 per cent. Five units of insulin were then given hypodermically simultaneously with 20 g. of glucose by mouth. The blood-sugar two hours later was as low as 0·027 per cent, mild symptoms of

FIG. 253.—Photograph showing severe emaciation, and the posture usually adopted when lying in bed.

hypoglycæmia occurring. On another occasion a similar procedure led to a very severe hypoglycæmic attack with sweating, tremor, convulsions, and loss of consciousness. Intravenous glucose brought about a speedy recovery, but no blood-sugar estimation was then carried out. This hypersensitivity to insulin, taken in conjunction with the tolerance test, indicates an increased carbohydrate tolerance.

3. The blood-urea was 0·021 per cent and the urine showed no chemical abnormality. The specific gravity was constantly low, 1010.

4. Serum calcium was 9·2 mg. per cent, plasma phosphorus 3·3 mg. per cent, and plasma phosphatase 0·136 per cent. There was therefore no chemical evidence of a disturbance of calcium metabolism, in

FIG. 254.—Radiograph of skull showing partial destruction of the dorsum sellæ and uneven calcification in the suprasellar tumour.

spite of the marked rarefaction of all the bones. Urinary excretion of calcium was not estimated.

5. The blood-count showed a secondary anæmia: erythrocytes 4,600,000; hæmoglobin 56, colour index 0·6; leucocytes 6200; differential count—polynuclear neutrophils 52·0 per cent, eosinophils 1·0 per cent,

small lymphocytes 36·0 per cent, large lymphocytes 10·0 per cent, large hyaline cells 1·0 per cent.

Radiography.—" The sella turcica is shallow, and the dorsum sellæ is eroded from above downwards; sutures not closed; irregular areas of calcification lie above the sella and I think in midline (*Fig.* 254). I suggest the presence of a calcified suprasellar cyst. The bones of the forearm are very small and thin, and show osteoporosis, but there is no abnormality of texture (*Fig.* 255). The epiphyses of radius and ulna (lower end) remain ununited with the shaft. All the

FIG. 255.—Radiograph of right forearm showing osteoporosis compared with normal control (C).

FIG. 256.—Wrist and hand showing delayed fusion of epiphyses.

bones of the hand are small, and all epiphyses are ununited (*Fig.* 256). There is no pelvic deformity. The heads of both femora are united but 'mushroomed'; the head of the left femur shows a peculiar cystic appearance; there is a loose body in the region of the right acetabulum (*Fig.* 257). The epiphyses of the knee-joints are ununited." (Dr. M. H. Jupe, Nov. 6, 1930, before admission.)

Further radiographs taken three months later by Dr. Vilvandre, Feb. 9, 1931, showed marked disorganization of hips, with osteo-arthritic changes, eburnation and flattening of the heads of the femora, and numerous large osteophytic bodies, some of which may have become loose (*Fig.* 258).

COURSE OF EVENTS IN HOSPITAL.—The most noticeable feature were the attacks of drowsiness which increased in frequency and duration, at first occurring occasionally for a few hours, but later occurring two or three times a week and lasting perhaps for some days. In the milder attacks the patient appeared rather sleepy with a slow reaction to questions, but could respond quite intelligently, although sluggishly. He would sometimes stop in the middle of an action, such as cleaning his teeth, and remain in a katatonic state with the tooth-brush held in his mouth in the one position and a vacant look on his face until roused. In periods of drowsiness he might become completely disorientated, imagining that he was at his own house, or describing an imaginary visit that he had just paid to his people. On one occasion on being roused from a sleepy state, he was seen to have a right external strabismus, with diplopia to the right and left. A peculiar state of rigidity occurred during the somnolent phases, and quite frequently persisted when full consciousness returned, so that during the latter months of life it was almost a constant feature. The arms were held in a flexed and rigid state with the hands near the face. It was impossible to extend the elbows, clonus of the arms being produced in this attempt. The reflexes of the arms were brisk; intention tremor was very gross. The hips and knees were acutely flexed and rigid, with some adduction spasm, and the reflexes all increased. The plantar response appeared to be normal or equivocal. On one occasion, during apparent deep sleep, there was complete flaccidity of the upper limbs, which gave way to persistent spasticity and elbow flexion at the moment of waking. Feeding was exceedingly difficult during the drowsy states, although the appetite was always very small and indifferent. With deeper somnolence it was quite impossible to rouse the patient to take food or to do anything else. On one such occasion a basal metabolic estimation was carried out without the knowledge of the patient, who had not the slightest

recollection of having undergone the procedure. During these phases, incontinence of urine and even of fæces occurred; urinary incontinence might also occur during the more normal periods. The pupils during somnolence were very small and did not react to light; they assumed their normal size and reactions if the patient could be roused to the waking state. Between the attacks of sleepiness the patient was bright, intelligent, and happy to the extent of

FIG. 257.—Radiograph of the pelvis, with mushrooming of the femoral heads, which contain cyst-like areas. The head of the right femur is flattened and projects well beyond the acetabulum which is more shallow than that on the left.

FIG. 258.—Radiograph, taken three months after *Fig.* 257, showing disorganization of right hip-joint.

euphoria. At times he displayed emotional negativism, apathy, and almost fatuous serenity. The headaches persisted on and off, as prior to admission. From about Dec. 7, 1930, the temperature became constantly subnormal, 96·5° to 97° F., and the respirations slower, 16. During the last ten days of life, the temperature dropped still further, 96° to 96·5° F., and the pulse became slower, 46 to 70 a minute, with long periods of marked bradycardia. The patient died quietly in his sleep on May 16, 1931.

TREATMENT.—The patient received an anterior pituitary preparation, which contained no growth hormone, but some gonadotropic hormone of pregnancy urine, 50 rat units per c.c. The object was to stimulate the development of the gonads, but no such result was obtained. Twenty-five rat units were given daily from Dec. 16 until Dec. 24, and from then up to Jan. 16 100 units daily. After an interval, he again received 25 rat units daily, from Feb. 23 until March 18. All injections were given hypodermically. No result was discernible, probably because of the low dosage, although another factor was the latent period of many years before therapy was attempted. In general, the hormone therapy employed by us was inadequate, quantitatively and qualitatively, because of the lack of available endocrine preparations at that time, 1931.

COMMENTARY ON THE SYMPTOMATOLOGY

The symptoms in this case were comparable to, or in large measure identical with, those occurring in the clinical condition of Simmonds' cachexia, and in the experimental condition of complete hypophysectomy. It will be seen from the pathology report that the pituitary stalk was destroyed, the posterior pituitary lobe almost completely destroyed, two-thirds of the anterior lobe replaced by cholesterin-crystal clefts surrounded by collagen and numerous foreign-body giant cells, and the remnant of the anterior lobe had undergone advanced degeneration. From this description it might be concluded that in all probability the whole of the pituitary gland was functionless, and, if so, this would be in keeping with the greater part of the symptomatology. It is useful to compare the latter with that following experimental hypophysectomy.

1. Failure of Sexual Development.—In 1910, Cushing and his co-workers showed that hypophysectomy caused an atrophy of the reproductive system. This work was confirmed by Aschner in 1912. Our patient showed infantile testes and penis, and a complete lack of development of primary and secondary sexual characteristics. Smith (1927) found that gonadal function after hypophysectomy could be restored by hypophysial implants, and since that time several workers have obtained extracts from the pituitary gland, from pregnancy urine, or pregnancy serum, which stimulate the genital glands of the immature, or hypophysectomized, animal. One gonadotropic hormone (prolan A) stimulates the seminiferous tubules, while another, (prolan B) stimulates the interstitial cells. The failure of our patient to respond to such therapy is probably accounted for by the inadequacy of the dosage employed, although the chronicity of the case before therapy was started might also have been a factor.

2. Failure of Skeletal Growth.—Aschner (1909) discovered that hypophysectomy in puppies was followed by the immediate arrest of growth and development. Dandy and Reichert (1925) showed that there is not the slightest increase in the shaft length of any long bone following

complete hypophysectomy. The epiphyses of the long bones tend to remain open in many species following hypophysectomy, but Freud, Levie, and Kroon (1939) found that the epiphyses of the tail and vertebræ of the rat tend to join after hypophysectomy and that this premature union can be prevented by the growth hormone, which is, therefore, only effective if given early. The epiphyses of the long bones were all ununited in our patient. Delay in the union of epiphyses is also a result of castration. Freud and colleagues (1939) also demonstrated interesting histological changes in the growth discs (tibia) of hypophysectomized rats. Thus, " the regular columns of cells, so characteristic of growing cartilage, show little or no development, while distended cells also are arranged differently, forming round groups as if they would prefer transverse proliferation. The mitogenesis of cartilage cells does not seem to have ceased entirely, but the typical arrangement of longitudinal growth is lost. The matrix has increased and is less regularly distributed among the cells. Very characteristic is the straight transverse boundary line between the growth zone and the diaphysial marrow cavity, the cancellous primary bone appearing to be cut off. The cavities of the cartilage cells are no longer open. One month after hypophysectomy a transverse bony plate closes the epiphyses, from which a number of massive bony processes project towards the diaphysial marrow cavity. Nothing is left of the fine structure of cancellous bone exhibited by normal rats of a similar age. The picture closely resembles that already described as characteristic of cessation of growth ". The reader is referred to the pathological research of Professor Turnbull in our case.

In 1921 Evans and Long reported the experimental production of gigantism in rats by long-continued daily injections of extracts of anterior pituitaries of cattle. Growth hormone is frequently contaminated with adrenotropic and thyrotropic hormones, but remains effective when separated from these. The clinical use of growth hormone is not always followed by success, as might be anticipated from the work of Freud and colleagues (1939). It was not available to us in a suitable form at the time this patient came under our care.

3. Hypoglycæmic Attacks.—Hypophysectomized animals have normal or subnormal blood-sugar values, according to the species, but prolonged fasting always leads to a fall in blood-sugar concentration, and fatal hypoglycæmia may occur in the dog (Lucke and others, 1934). The carbohydrate tolerance in hypophysectomized animals is normal, or increased, and the sensitivity to insulin is very great, even small doses leading to fatal hypoglycæmia (Lucke, 1934). Our patient behaved as a hypoglycæmic animal, and, on one occasion, as little as 5 units of insulin, although balanced by 20 g. of carbohydrate given by mouth at the same time, produced severe hypoglycæmic convulsions that would have probably been fatal if intravenous glucose had not been administered.

4. Metabolism.—Foster and Smith (1926) demonstrated that hypophysectomy in the rat was followed by atrophy of the thyroid, and that the basal metabolic rate was decreased by some 35 per cent. Associated with the low metabolic rate is a subnormal temperature, especially on exposure to cold. Our patient had a basal metabolic rate of − 52 per cent, and in the later stages of the disease a subnormal temperature of 96° to 97° F. At autopsy there was no atrophy of the thyroid but there was evidence of deficient colloid transference.

5. Diabetes Insipidus.—The occurrence of diabetes insipidus in our patient was associated with destruction of the posterior lobe of the pituitary gland, the pars tuberalis and subthalamic nuclei. The degree of severity of this disturbance might have been greater if the anterior lobe of the pituitary had functioned, since by its effect on general metabolism, the anterior lobe has a diuretic effect.

6. Other Features.—Some of the remaining symptoms, such as progeria, dryness, atrophy, and pallor of the skin, weakness and wasting, anorexia, hypotension and bradycardia, are more easily seen in man (Simmonds' disease) than in the hypophysectomized animal.

7. The Role of the Adrenal Cortex in Symptomatology.—It should be pointed out that just as Simmonds' disease has many features in common with Addison's disease, so does the hypophysectomized animal resemble in some respects the adrenalectomized animal. In fact, the administration of extracts of the suprarenal cortex to the hypophysectomized animal produces a gain in weight and strength, a rise in basal metabolism, and an elevation of a subnormal temperature, an improved ability to withstand cold, and a better appetite. Such extracts, or the synthetic hormone (desoxycorticosterone), may have a similar favourable effect in Simmonds' cachexia, and now that they are available should be tried in such cases.

8. Narcolepsy.—Symptomatic narcolepsy is to be distinguished from the somnolence associated with increased intracranial pressure, and the apathy and torpor that occurs in hypopituitary states as an expression of low metabolism. It is characterized by periodicity. That is to say, the patient has attacks of irresistible sleep, and in between these attacks may be quite bright and mentally active. Usually the patient is easily aroused from his sleep, but may require violent shaking. The frequency of occurrence and the duration varies enormously. Associated attacks of cataplexy frequently occur, in which there is sudden loss of tone of all the muscles, the patient falling to the ground, and being quite unable to move, or speak, but with complete consciousness persisting. Emotion is frequently an exciting factor of cataplectic attacks.

The term ' narcolepsy ' was first used in 1880

by Gelineau, who claimed to have separated a peculiar form of neurosis from the epilepsies. In his patient, as in the majority of cases with narcolepsy, there was no evidence of a pituitary tumour. Adie (1926) suggested that the term 'idiopathic narcolepsy' should be used for these cases. Occasionally there are coincident signs of aberrant function of the pituitary gland. No case of idiopathic narcolepsy has yet come to necropsy. Narcolepsy is used as a comprehensive term to include cataplexy, and Cave (1931) stated that "all gradations between sleeping attacks without cataplexy to cataplexy without sleeping attacks may occur". Hercouët, in 1905, from a study of sleep occurring with cerebral tumours, suggested a sleep centre at the base of the brain. Fulton and Bailey (1929) describe the occurrence of narcolepsy with tumours of the third ventricle, and conclude that the responsible lesion is a hypothalamic one, probably in "a posterior situation near the anterior extremity of the aqueduct of Sylvius". Cushing (1925) also pointed out that "Pathological somnolence is prone to accompany such of the craniopharyngiomas as cause deformation of the third ventricle". Hess (1929) demonstrated a definite hypothalamic area in the cat, stimulation of which produced sleep.

In our case, there were definite and frequent attacks of narcolepsy and cataplexy, long before there was any question of a general increased intracranial pressure. The periodic sleeping attacks were remarkable for their variation in depth, sometimes a light touch being sufficient to rouse the patient, and on other occasions a shaking, or the carrying out of a complete metabolic test, might fail. Nevertheless, on the waking state being attained, the patient was immediately mentally active and responded to questions brightly and intelligently. Blurring of vision and diplopia were sometimes associated with, or followed, these attacks. Cave (1931) described such effects and regarded them as "a transient imbalance of the extra-ocular muscles resulting from the patchy or uneven distribution of the loss of muscle tone".

A further interesting feature in our case was the occurrence of trance-like conditions, suggestive of catatonia or catalepsy. Thus in the middle of cleaning his teeth the patient would remain stationary for an indefinite period with the toothbrush held in his mouth and a vacant look on his face. On being spoken to about this, he would continue brushing his teeth as if nothing unusual had happened.

9. Rigidity.—West (1931) described a case of pituitary cyst with "tonic fits resembling tetany". Walshe (1923) and Davis (1925) both described cases of suprasellar cyst associated with decerebrate rigidity. Fulton and Bailey (1929) noted pyramidal and extrapyramidal symptoms in 3 out of 4 cases of third-ventricle tumours. They also quoted a case of third-ventricle tumour described by Guillain, in which rigidity in all four limbs occurred in attacks, during which the patient could not be roused. Rigidity was a late feature in our patient. At first it occurred only during the somnolent phases, later persisting for an indefinite period afterwards, and finally being a constant feature. The arms were acutely flexed at the elbows, and rigid. Attempts to straighten them resulted in coarse clonus. The lower limbs were rigid, but flexed at knee and hip, with spasm of the adductors. All the tendon reflexes were exaggerated.

10. Mental Changes.—Fulton and Bailey (1929) observed in patients with third-ventricle tumours an emotional negativism, fatuous serenity, and failure to appreciate the gravity of their conditions. These abnormal manifestations were present in our patient. In addition there were periods of complete disorientation of time and place.

PATHOLOGICAL REPORT

(*Dorothy S. Russell and Hubert M. Turnbull*)

SUMMARY OF NECROPSY, P.M. 228, 1931.—Puerile nanosomia and Simmonds' cachexia. Destruction of pituitary gland and hypothalamic nuclei. Suprasellar cyst of Rathke's pouch. Greatly wasted proportionate body, equivalent in size to that of boy from 10 to 12 years old. Wizened, wrinkled face. No hair on face, pubes, axillæ, or elsewhere except scalp. Hands large in proportion to body, with long fingers and ulnar deviation at metacarpo-phalangeal joints. Recession of gums and considerable caries of teeth. Arrest of development of testicles (right 1·8 × 1·3 × 0·8 cm., left 1·5 × 1·2 × 0.8 cm.) before 14 or 15 years of age. Great hypoplasia of prostate (1·8 cm. diam.). Penis 11 cm. from veru montanum to meatus; glans 1·7 cm. from corona to tip × 1·5 × 1·2 cm., with somewhat tight foreskin. Slender, porotic long bones. Persistent cartilages of conjugation in femur: complete and 0·1 cm. deep in lower end, interrupted beneath great trochanter, and very slender beneath head. Complete cartilage of conjugation (up to 0·2 cm. deep) in upper end of humerus. Slight active endochondral ossification in rib and, with mucinous and asbestos degenerations, in diaphysial portion of conjugal cartilage in upper end of humerus. Calvaria 0·3 to 0·4 cm. thick. Puerile costal cartilages. Osteo-arthritis: considerable distortion of head of right femur, with depressions and sulci in articular cartilage. Other bones not examined. Sparse glandular tissue in small thin adipose thymus. Left upper parathyroid gland (0·35 × 0·3 × 0·15 cm.) and right lower (0·5 × 0·15 × 0·1 cm.) alone identified. Colloid thyroid. Small islands in a pancreas of size proportionate to rest of body. Shallow (0·05 to 0·07 cm.) suprarenal cortex, without disturbance of microscopic structure; medulla up to 0·25 cm. wide.

Brown atrophy of myocardium. Slight general atheroma. Slight œdema and congestion

of posterior parts of lungs. Brown atrophy and slight congestion of liver. Slight ischæmic atrophy in kidneys. Considerable hypertrophy of urinary bladder. Post-mortem digestion of body of stomach. Obliteration by fibrous tissue of lumen of terminal 1·5 cm. of 6-cm. appendix, without peritoneal adhesions.

Weights: Body, 19·2 kg. (height, 136 cm.); heart, 148·8 g.; liver, 609·5 g.; kidneys, 113·4 g.; spleen, 78 g.; brain, 1190·7 g.; suprarenals, 3·65 g.; thyroid, 5·1 g.; thymus, 4·95 g.; pancreas, 32·65 g.; pituitary, 0·8 g.; left testicle, 0·85 g.

CONTENTS OF SKULL

Macroscopical.—

Brain.—On removing the top of the skull the dura was tense and the underlying cerebral convolutions flat and dry. The left frontal lobe was abnormally full, and indented the opposing mesial surface

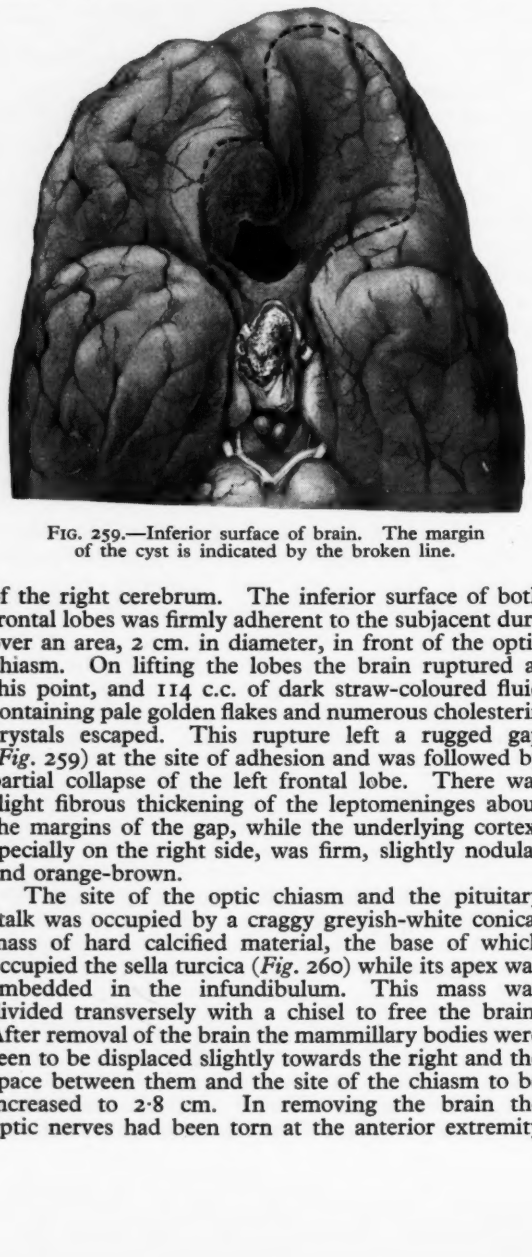

FIG. 259.—Inferior surface of brain. The margin of the cyst is indicated by the broken line.

of the right cerebrum. The inferior surface of both frontal lobes was firmly adherent to the subjacent dura over an area, 2 cm. in diameter, in front of the optic chiasm. On lifting the lobes the brain ruptured at this point, and 114 c.c. of dark straw-coloured fluid containing pale golden flakes and numerous cholesterin crystals escaped. This rupture left a rugged gap (*Fig.* 259) at the site of adhesion and was followed by partial collapse of the left frontal lobe. There was slight fibrous thickening of the leptomeninges about the margins of the gap, while the underlying cortex, specially on the right side, was firm, slightly nodular and orange-brown.

The site of the optic chiasm and the pituitary stalk was occupied by a craggy greyish-white conical mass of hard calcified material, the base of which occupied the sella turcica (*Fig.* 260) while its apex was embedded in the infundibulum. This mass was divided transversely with a chisel to free the brain. After removal of the brain the mammillary bodies were seen to be displaced slightly towards the right and the space between them and the site of the chiasm to be increased to 2·8 cm. In removing the brain the optic nerves had been torn at the anterior extremity of the calcified mass and the chiasm could not be identified. The left oculomotor nerve was flattened.

Median sagittal section of the brain disclosed a large cyst (*Fig.* 261, A, B) which had destroyed the septum pellucidum. It displaced the genu of the the corpus callosum to the right, and, extending into the left frontal lobe, invaginated the anterior horn of the left ventricle, reaching a point 0·9 cm. distant from the left frontal pole. It also bulged to a less extent into the anterior horn of the right lateral ventricle. The wall of the cyst was composed of translucent pearly-grey tissue, up to 0·1 cm. thick, with a slightly corrugated or smooth inner surface upon which were deposited collections of opaque creamy-white or brownish-white amorphous debris. Apparently continuous with the ventral part of the cyst wall and expanding the floor and anterior wall of the third ventricle was an ill-defined triangular orange-brown mass, 2·25 cm. from above down by 2·5 cm. from before back, of tough opaque greyish-brown tissue that formed a cap over the apex of the calcified mass attached to the sella turcica (*Fig.* 261, A). This tissue extended backwards in the floor of the third ventricle as far as the mammillary bodies. In its uppermost part, adjacent to the descending pillars of the fornix, was a sharply defined opaque creamy-yellow mass, measuring 0·4 by 0·3 cm., of cholesterin crystals surrounded by a dark brown zone.

The pineal gland, the cavity of the third ventricle, and hinder part of the brain appeared normal except for the presence of a cerebellar pressure-cone up to 0·9 cm. long.

Sella Turcica and Pituitary Body.—The craggy calcified mass at the base of the brain was united by fibrous adhesions to the tuberculum sellæ and the upper concave surface of the diaphragma sellæ. It appeared to replace the pituitary stalk. The underlying pituitary body appeared to be of normal size and shape, and weighed 0·8 g. with its dural sheath. On median sagittal section the centre of the posterior lobe was occupied by a nodule of bone measuring 0·45 by 0·3 cm.; the rest of the gland was composed of yellow and brown opaque tissue streaked with pearly grey. A few cholesterin crystals were observed on the cut surfaces. Near the anterior extremity of the gland was a small cyst, 0·5 × 0·2 cm., containing colourless fluid. The sella turcica when empty measured 1·5 cm. from before backwards and 1·4 cm. from side to side.

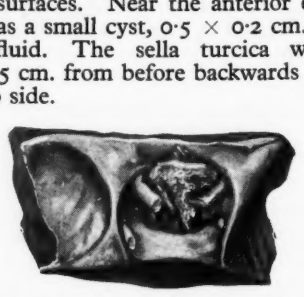

FIG. 260.—A portion of the skull, showing the pituitary fossa and its contents.

Microscopical.—After fixation in 4 per cent saline-formaldehyde the right half of the hypothalamus was divided into a series of five blocks of approximately equal thickness. These, with the pituitary body and portions of the cyst wall from the region of the septum pellucidum and from the left frontal pole respectively, were embedded in paraffin. Sections were stained with hæmatoxylin and eosin, Weigert's iron hæmatoxylin and Van Gieson's mixture, Weigert's fuchselin and neutral red and phosphotungstic acid-hæmatoxylin. The left half of the brain was mounted as a museum specimen.

The Hypothalamus.—The tuber cinereum and pituitary stalk are replaced by masses of calcium which often have a laminated structure. In some places, especially at the site of the pituitary stalk, the calcium is replaced by thin trabeculæ of lamellar bone. The interstices between the calcified masses are occupied by collagenous tissue which also extends as a thin capsule round the whole collection. In the neighbourhood of the bone the collagen is occupied by capillaries, fibroblasts, osteoclasts and a few lymphocytes and myelocytes. Surrounding the calcium and bone is a zone of dense gliosis formed by interlacing, mainly spindle-shaped, fibrillary astrocytes. This gliosis is most dense in the floor of the third ventricle, which is greatly thickened thereby. It ends posteriorly as a thin tongue separating the mammillary bodies. A rounded area of cholesterin-crystal clefts is present in the dorsal part of the gliosis adjacent to the anterior commissure.

A B

FIG. 261.—Median sagittal sections of brain. A, Right half; B, Left half.

The optic tract, which is indented mesially and displaced outwards, has undergone considerable gliosis, especially of its mesial border. The site of the supra-optic nucleus is occupied by gliosis, and no trace of the nucleus can be seen. The nucleus of Meynert appears normal. The paraventricular nucleus is involved in gliosis and contains fewer neurones than in control specimens; those present are small and often degenerated. All tuberal nuclei have been destroyed except a few neurones that lie dorsolaterally to the descending column of the fornix. The mammillary bodies are intact, but laterally compressed. At this coronal plane gliosis is restricted to the narrow wedge that separates them.

The Cyst.—The wall varies in thickness, but is generally very thin. It is lined with squamous epithelium composed of a layer, from one to three cells deep, of flattened cells resting upon a basal layer of low cubical cells with round or oval nuclei and scanty cytoplasm. This epithelium lies upon a compact layer of collagen containing a few spindle fibrocytes. Outside this is a less compact zone of collagen which merges into the fibrillary glia derived from the surrounding brain. In the collagen of the cyst wall in the frontal pole are focal collections of cholesterin crystal clefts and areas of infiltration with lymphocytes and macrophages containing iron pigment.

The Pituitary Body.—The centre of the posterior lobe is replaced by a large mass of lamellar bone (*Fig.* 262). This is enclosed in dense fibrous tissue, embedded in which, behind the bone, is a minute island of the posterior lobe proper. The posterior two-thirds of the anterior lobe are replaced by a collection of elongated cholesterin-crystal clefts surrounded by collagen and numerous foreign-body giant cells. In front of this is a remnant of anterior lobe proper in which the collagenous stroma is greatly thickened. Many of the acini have disappeared, leaving empty spaces; the remainder are greatly shrunken and their cells show advanced degeneration. All three types of cell are recognizable, including a moderate number of acidophil and fewer basophil cells. The chromophil cells are abnormally small.

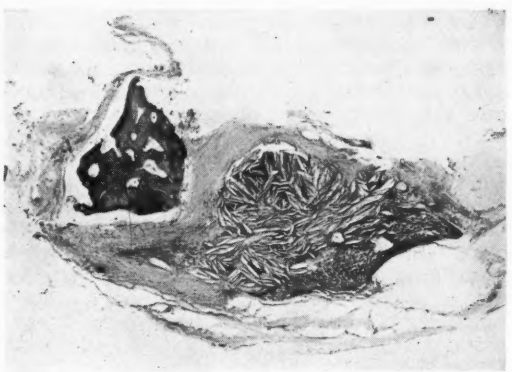

FIG. 262.—Median sagittal section of pituitary gland. (H. and E.) (× 5.)

Summary.—A large epidermoid cyst occupied the region of the septum pellucidum and left frontal lobe. The anterior wall and floor of the third ventricle and the anterior part of the hypothalamus were replaced by dense glial tissue, the tuberal region and pituitary stalk by calcium salts and lamellar bone. No trace was found of the supra-optic nucleus and the greater part of the tuberal nuclei; the paraventricular nucleus was considerably destroyed. Although the pituitary gland had retained its normal size and shape, both lobes had undergone profound histological changes; the posterior lobe was almost completely replaced by bone and fibrous tissue, while the remnant of anterior lobe showed advanced degeneration. Although the right side of the hypothalamus only was examined microscopically, it is fair to assume that the changes were similar, if not more severe, on the left side, which included the greatest bulk of the cyst.

D. S. R.

DUCTLESS GLANDS

Microscopical.—

Thymus.—The section includes the whole breadth of the thoracic part of the thymus at its centre. The adipose tissue is traversed by narrow branching strands of glandular tissue, from 20 to 120 μ wide, which show a few focal expansions, of which the largest is 340 μ wide. Nowhere can cortex and medulla be distinguished. There are no fully developed concentric Hassal bodies, and only three small groups of large epithelial cells, representing incipient Hassal bodies. There are six concretions.

Parathyroid Glands.—At one pole of the left upper gland in a group of acini of pale oxyphil cells. Excepting a few scattered pale oxyphil cells, chiefly in the neighbourhood of this group, the remaining cells are principal cells. Many of these are of the dark variety, but most are spongy (transitional); the water-clear variety is very sparse.

In the right lower gland pale oxyphil cells are sparse and scattered. The relative numbers of the varieties of principal cells are very similar to those in the left upper gland. In the periphery are many small, columnar-celled alveoli lined with transitional or dark principal cells. They contain a coagulum which is stained lightly or moderately deeply by eosin. One alveolus containing coagulum of the deeper shade is surrounded by cubical cells and thus approximates to a typical colloid vesicle. Deeper in the gland is a conspicuous group of alveoli containing a similar coagulum, but lined with very large water-clear cells; most of the lumina are larger than those lined with principal cells. About and between them are some groups of large water-clear cells, which may well be tangential sections of similar alveoli.

Thyroid Gland.—In a sagittal section through the whole of one lateral lobe the lobules are slightly less angular than normally and one group forms a rounded area 1 by 0·6 cm. in diameter. The vesicles vary in mean diameter from 50 to 445 μ, while most are about 170 μ. They are round, rounded or oval, and are filled with a thin colloid, stained pale pink by eosin. In a few vesicles the colloid contains a large clear vacuole. They are lined chiefly by a layer of cubical or slightly flattened cubical cells with relatively large round or slightly oval, lightly stained nuclei, but among these are occasional cells with smaller almost pyknotic nuclei and, rarely, part of the lining is formed by more flattened cells with elongated oval nuclei. Several of the smaller vesicles contain desquamated cells. The thyroid gland, therefore, shows no atrophy, and thus contrasts very conspicuously with the extremely atrophied gland in the man of fifty with Simmonds' disease of whom a description was given by Aitken and Russell (1934). There is evidence, however, of deficient colloid transference.

Pancreas.—Segments were taken from the head, body, and tail. The interlobar and lobular septa are slender. The parenchyma is well preserved and free from digestion. There is one small area of intralobular fibrosis in the head and another in the body. The islands are in general distinctly smaller in the head than in a control from a male of 40 and in the tail than in a control from a female of 48, but they show no structural abnormalities.

Suprarenal Body.—Although the cortex was very narrow on measurement, it shows no alteration of the normal pattern microscopically. The cells of the zona fasciculata are usually swollen and foamy from abundant lipoid and the cells of the zonæ glomerulosa and reticulata above and below are sometimes affected similarly. There are, however, as is usual in adults, focal areas in which the outer part of the trabecular zone is free or almost free from lipoid. Pigment in the zona reticulata is scanty. There is no abnormality in the medulla.

The Left Testicle.—The tubuli contorti when cut transversely are seen to be lined with a single row of cells, of which most have an abundant elongated cytoplasm and are obviously Sartoli cells. Among them are small, cubical, polygonal, or rounded cells with deeply stained nuclei, and also considerably larger, free, round cells with abundant, sometimes vacuolated, cytoplasm and a relatively large nucleus, which either is pale and shows very numerous small nodes in a narrow-meshed net of delicate threads of chromatin or is so deeply stained that its structure is obscure; 'basket' nuclei and karyokinetic figures were not found. One or two large cells sometimes lie internal to the epithelial lining. There are cells intermediate in size and appearance between the small and the largest. The small cells with dark nuclei are doubtless resting spermatogonia. From their nuclear structure and their usual position against the basement membrane, the large cells appear to be fully developed spermatogonia. Very rarely the lining cells in part of a tubule surround a sphere of eosinophil coagulum; otherwise there is no lumen. The tubules are surrounded by a conspicuous, wide (often 20 μ) zone of hyaline collagen which rarely contains one or two concentric spindle cells and corresponds to a swelling of the innermost layer of the membrana propria, a layer to which Koelliker (1902) confined the name of membrana propria. Outside this is a single layer of concentric spindle cells and a few delicate collagen fibres, but no elastic fibres are demonstrated by either Hart's or Verhoeff's method. The interstitial tissue in a few small areas consists of a wide-meshed net of delicate collagen fibrils carrying spindle cells. Elsewhere stouter fibrils and long narrow spindle cells lie in a matrix which is usually stained pink by van Gieson's method, but in denser areas is stained a deeper pink. In these denser areas the hyaline basement membranes are at their widest. Extremely few interstitial cells were found.

In atrophy of the testicles of adults, for instance syphilitic fibrosis with atrophy, wide hyaline collagenous zones round the tubules are bounded by a conspicuous zone of elastic. In an example of pure atrophy of the testicles in a case of Simmonds' syndrome, reported by Aitken and Russell (1934), the hyaline zone is surrounded by three to five rows of deeply stained elastic fibres. The patient was 50 years old when symptoms appeared and rapidly led to death. These observations suggested that the atrophy of the testicles in the present case occurred at an age before an elastic layer was developed in the wall of the tubuli contorti. Examination was made, therefore, of a large number of reserved specimens of normal testicles, stained by Hart's method, to determine the age at which elastic fibres are developed. These included 22 examples between the ages of 11 and 17, the age of 15 being alone not represented. No definitely stained elastic fibres were found before 14 years. At that age a few were found. At 16 years definitely stained fibres in one to four layers were seen in the walls of a variable number of tubules. The staining was usually feeble. In later years elastic fibres were present round all tubules and the staining increased in depth. It is reasonable, therefore, to conclude that in the present case arrest of development of the testicles began before the patient was 14 or 15 years old.

H. M. T.

COSTAL CARTILAGES AND BONES

Microscopical.—The 5th left rib and the upper end of the right humerus were fixed in 4 per cent saline-formaldyhyde, decalcified in Müller's fluid for six months and ten days followed by 0·5 per cent nitric acid in 4 per cent formaldehyde for three and a half days, and embedded in celloidin.

Costal Cartilage.—In the section of the 5th left rib the costal cartilage is 11 mm. long. It is only 6 mm. deep from the pectoral to thoracic surface, while that of a control male of 44 years is 12 mm. On the pectoral side a subperichondrial layer of translucent, very lightly stained cartilage is defined by a sharp line from more deeply stained cartilage beneath (*Figs.* 263; 264, B). This special layer begins in most sections at a sharply defined spot 3 mm. from the costochondral junction, expands rapidly to a depth of 200 μ and deepens fairly evenly to 370 μ at the chondral end. On the thoracic side a similar layer, about 550 μ deep, is clearly defined for 5·5 mm. from the chondral end, but its inner part is then occupied for 2 mm. by a longitudinal band of asbestos degeneration, at the end of which its differentiation from the subjacent cartilage has been lost. This longitudinal band of asbestos degeneration merges into a transverse band of advanced asbestos degeneration which lies 3 mm. above the costochondral junction (*see Fig.* 266). Beneath it two transverse bands of advanced, and two of incipient, asbestos degeneration are found in some sections.

In sections stained with hæmatoxylin and eosin this cartilage has a pale-blue matrix. The cells are very scanty. Small spindle cells, usually in a single layer, lie immediately under the perichondrium and parallel to it, and are followed by a narrow zone of small round cells. Then larger round cells quickly give place to large spindle cells which lie singly or in groups within a delicate capsule and are directed at, or almost at, right angles to the surface. Even when the stain is preceded by mordanting in iron alum the matrix is evenly stained and there are no halos round the cells.

In the more deeply stained cartilage beneath this the following zones of cells are seen from without inwards (*Fig.* 264, B):—

a. A zone of small spindle cells parallel to the surface and four to five tiers deep on the pectoral side, but represented by only an occasional cell on the other; the cells lie in a slightly eosinophil matrix. This zone corresponds to Zone I of the five successive zones described and figured by Schaffer (1920) in the costal cartilage of a man of 33, and accepted and numbered by Böhmig (1928–9) in his study of the changes in costal cartilages at different ages.

b. A shallow zone of small round cells, also in a slightly acidophil matrix—Zone II of Schaffer.

c. A relatively deep zone in which round and spindle cells or spindle-shaped 'brood capsules' rapidly become larger, and flow in different directions obliquely to the surface and ultimately at right angles to it. The capsules are surrounded by a pale basophil halo, which becomes wider in the deeper layers, while the matrix between the halos is more deeply basophil. This is Schaffer's Zone III.

d. Finally a basophil halo appears within the pale halo and very rapidly becomes more deeply stained and wider, while the remnant of pale halo becomes more eosinophil. The cells then appear as large, deep-blue spheres surrounded by a narrow conspicuous pink ring in a blue or purplish-blue matrix. This is Schaffer's Zone V or core. Between the cells characteristic of this zone are many spindle and small round cells. A very few spindle cells have a basophil cytoplasm and appear to be healthy. Most cells are cells of Zone V, showing stages of degeneration and necrosis. The cytoplasm is at first homogeneous and deeply eosinophil and the nucleus pyknotic, while the basophil halo becomes ever fainter and disappears. Then the cell shrinks to a small pink sphere with a pyknotic nucleus in a round cell-space and the capsule is wide and often oval but very pale. Later the small round cell-space is empty except for a pyknotic nucleus against one wall and the capsule has gone; very few completely empty cell spaces of this kind could be found.

A very small arteriole with a vein can be traced in different sections passing transversely inwards from the perichondrium on each side at three levels, the lowest being immediately above the zone of provisional proliferation. The chondral canal of one in the central tier is seen to widen towards the centre of the cartilage. The rim of these transverse canals is deeply hæmatoxyphil in places and is surrounded by a narrow eosinophil zone. In the centre of the cartilage opposite the vessels of the upper two tiers there are two rounded areas of deeply basophil cartilage, which presumably lie in the margins of central chondral canals.

The bilateral pale layers of cartilage lie between the perichondrium and Zone I of chondral cartilage of normal appearance. The cells are arranged as in Schaffer's outer three zones, but are surrounded by neither the dark basophil halos seen towards the end of the first year nor the pale halos which soon replace them. Further, the cells in all zones are much scantier than in normal costal cartilages at any age. The layers differ conspicuously from the focal groups of polygonal cartilage cells which may be found at all ages within the perichondrium, and which sometimes extend into Zone I or, in subjects over 40, into Zone III (Böhmig). They appear to be deposits formed relatively recently to bring the cartilage to the same depth as it is for a short distance above the costochondral junction. An anterior pituitary preparation had been administered to the patient. It contained, however, no growth hormone. The layers cannot, therefore, be attributed to this treatment. Any growth caused by pituitary extract would, moreover, be

expected to take place within Zone III of the original cartilage beneath, as in the case of acromegaly referred to below.

The naked-eye and microscopical appearances of costal cartilages alter with age. It seemed important, therefore, to determine whether the diminution but abnormal prolongation of growth in the costal cartilage, within the bilateral deposits, was associated with retardation of age-changes. For this purpose a series of costal cartilages from normally developed subjects at different ages was examined. The results differed in several respects from those published by Böhmig.

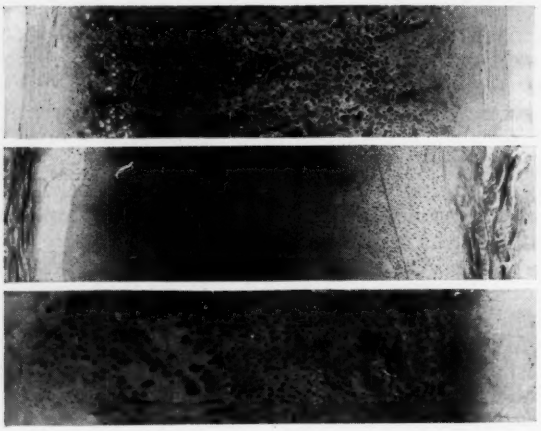

FIG. 263.—Costal cartilages. (H. and E.) (× 10.) A, Normal female, aged 15; frozen section. B, The patient, dwarf male, aged 43; decalcified, celloidin. C, About half depth of cartilage, normal male, aged 44; decalcified, celloidin.

Cartilages of the fourth or fifth ribs were either taken with a strip of bone, fixed in 4 per cent saline-formaldehyde, decalcified in Müller's fluid for one month, followed by 0·5 per cent nitric acid in 4 per cent formaldehyde under X-ray observation, and embedded in celloidin so as to be controls to the specimen described above, or they were severed from the bone, fixed in formaldehyde, and cut upon the freezing microtome for comparison with Böhmig's findings. In both cases they were stained with hæmatoxylin and eosin, because this was one of the two methods selected by Böhmig and the only method of Erdheim (1931). Different depths of stain with hæmatoxylin were prepared in each case. Preparations of cartilages at 2, 4, 5, 16, 17, and 18 years were unfortunately lost in the dispersal of the Institute on the declaration of war. There remained for examination a series of 29 specimens between the ages of $3\frac{1}{2}$ and 66 years inclusive.

Schaffer's Zones I and II became narrower in males of 31, 35, 44, and 47 (two); in a male of 51 they were very narrow, and in males of 53, 59, and 66 not only very narrow but absent in many places. They had evidently been converted from within outwards into Zone III and later Zone IV.

Zones III and IV: Schaffer's Zone III extended throughout the core where cells of Zone V had not developed, so that it did not become a defined zone until Zone V occupied all the core—at 9 years and constantly from 14 years on (*see below*). Between Zones III and V there first appeared in a male of 20 years groups of cells with deeply basophil wide halos which were for the most part confluent but were occasionally separated by a narrow eosinophil crescent or by a narrow process of eosinophil matrix. Associated with these groups were a few similar cells completely separated by narrow strips of eosinophil matrix, but these strips when wide were often basophil centrally so that the characteristic appearance of Zone V resulted. In a male of 23 and at subsequent ages similar groups of cells and isolated, but closely packed, cells formed a conspicuous deeply stained continuous zone between III and V. This zone is doubtless Schaffer's Zone IV, which he described as a zone in which the pale basophil halos of Zone III become deeper basophil and the matrix is oxyphil. This Zone IV of Schaffer is developed from Zone III, because after 20 an increasing depth of the typical Zone III of younger subjects is converted into it from within outwards. In the cartilage of the 5th right rib (decalcified and embedded in celloidin) of a male of 44, narrow, relatively pale basophil halos appear within the pale halos of the outer part of Zone III and increasing in width and in depth of stain merge into halos typical of cells of the dark Zone IV (*Fig.* 264 C). Zone IV, therefore, approaches the surface as age proceeds, and at the ages of 53, 59, and 66 has actually reached the perichondrium in places. At the same time it is encroached upon by Zone V, so that over 50 its depth is obviously less than the combined depth of Zone III and IV at earlier ages.

Zone V: At $3\frac{1}{2}$ years a few cells characteristic of this zone were detected towards the rib. At $5\frac{11}{12}$ they occupied a large area towards the rib and there were a few elsewhere. At 7 they were much more abundant, and increasing in number at 8 they occupied the whole core in girls of 9 and 11. In a boy of 11, however, they were absent, and in girls of 12 and 13 they were abundant towards the bone but less numerous distally. In subjects of 14 and over, Zone V consistently occupied the core except for a variable number of apparently healthy spindle cells and degenerating cells. At 35 years and later the loss of cells in Zone V became obvious when compared with the age of 20, and was conspicuous in subjects over 50 years.

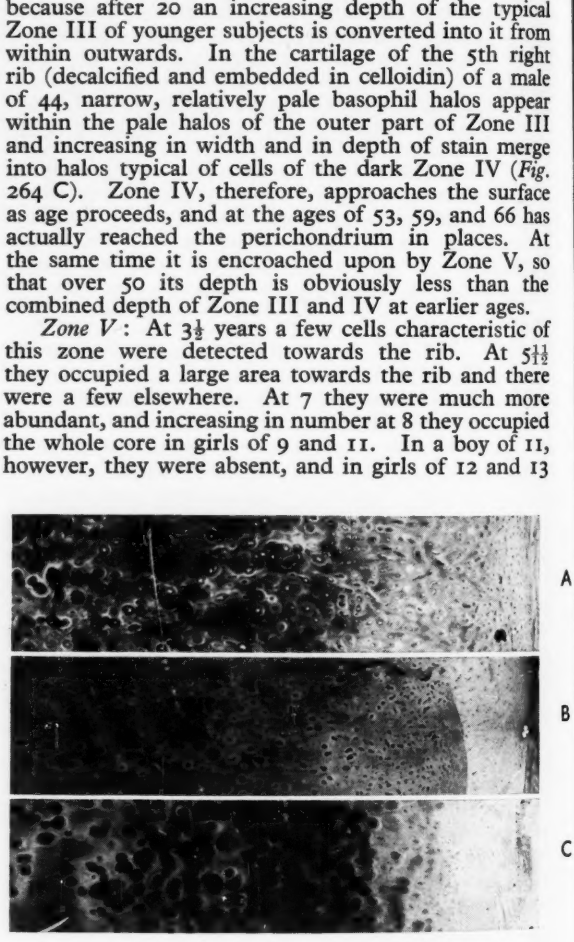

FIG. 264.—Costal cartilages. (H. and E.) (× 24.) A, Normal female, aged 15; frozen section. B, The patient, dwarf male, aged 43; decalcified, celloidin. C, Normal male, aged 44; decalcified, celloidin—note compact dark 'Zone IV'.

Although in hæmatoxylin and eosin the matrix in the core is stained a deeper blue than the outer cortical zones, in Jenner's stain the core is pink and the cortex blue.

The examination of the normal cartilages gives two relatively precise criteria for estimating age—first, the occupation of the core by Zone V, and secondly the formation of Zone IV. A criterion subject to more variation is the amount of degeneration in the core.

Zone V occupied the core in a subject of 9 years, but this condition was not constant until 14 years and later. The number of degenerating cells in the core of the dwarf suggests, however, a considerably later age than 14. This degeneration leads to loss of cells. When the core in the dwarf of 43 is compared with that of the man of 44 there appears to be less loss of cells (*Fig.* 263, B, C). Further, in the dwarf the lateral chondral canals are surrounded by a very narrow zone of eosinophilia and there are certainly no wide areas of eosinophilia round the central canals. At 3½ years the canals are surrounded by a narrow eosinophil zone which at 19 has become two to three times as wide, the width being greater round the central canals and greatest round that nearest the bone (lowermost). At 20 the canals are surrounded by a much wider eosinophil zone and the zone contains few cartilage cells. The zones round the central canals are particularly wide and are more degenerated and extensively vascularized. At later ages the zones become still wider, and softened areas often appear in them. In the man of 44 there are large cavities containing bone and fatty marrow in the zone round the lowermost central canal, or segment of a continuous central canal, which extends upwards for 1 cm. No other cartilage in the series contains bone. The cartilage of the dwarf shows little asbestos degeneration. Asbestos degeneration was present in the normal series at 9, 10, and 11 years, and in one specimen at 11 years was more widely distributed than in the dwarf.

Definite evidence of great retardation of age changes in the cartilage of the dwarf, within the bilateral deposits, is given by the normal development of Zone IV. This zone was present in places at 20 years and was conspicuous as a continuous dark zone at and over 23 years. The zone is absent from the dwarf but is conspicuous, and is encroaching extensively on Zone III, in the control of 44 years (*Fig.* 264, B, C). The cartilage of this pituitary dwarf thus contrasts conspicuously with that described by Erdheim in an acromegalic woman of 71 whose pituitary contained a sharply defined acidophil adenoma (15 × 13 mm.). Growth confined to Zone IV and occasional small remnants of Zone III has caused these combined zones to be, in comparable microphotographs, over three times as deep as in a control woman of the same age, while the cells in Zone IV are larger and their dark basophil halos much larger. Erdheim calls this wide zone the equivalent of Schaffer's Zone III. From his description and microphotographs it corresponds histologically almost entirely to Schaffer's Zone IV, but it has been shown above that Zone III becomes largely or completely replaced in old age by Zone IV, so that Zone IV is the senile equivalent of Zone III, which Schaffer said was the zone of most obvious interstitial increase. It must be understood, however, that this contrast between the cartilage of the dwarf and that of the acromegalic old woman is not due to a similar process. In the dwarf age-changes have been retarded so that Zone IV has not appeared; in the acromegalic woman abnormal growth has taken place in a Zone IV; according to Erdheim the acromegaly had not arisen in youth, because the growth in this layer decreased as the costochondral junction was left behind, whereas in acromegaly which has started in youth and lasted a long time the growth extends over the full length of the cartilage.

The costal cartilage in the dwarf shows, therefore, not only diminution of growth, but retardation of age-changes. This is further shown by the persistence, mentioned below, of a deep zone of the type of Zone III between the zone of provisional proliferation and the core of Zone V. The cartilage is distinctly puerile.

The 5th Left Rib.—The core formed by Zone V in the costal cartilage ends about 3 mm. above the costochondral junction. Below this the cells are, as in Zone III, surrounded by a pale basophil halo and lie in a deeper basophil matrix. In sections at some distance from the centre of the rib the junction of the cartilage with the rib is straight. Across the cartilage is a zone of provisional proliferation which varies in depth from 120 μ to 175 μ, but is usually between 140 μ and 150 μ. It consists of a row of stout short columns of cells, usually alternating at slightly different levels, and above them a few small clumps of cells at two levels. The zone of provisional calcification is relatively deep. Decalcification has been carried too far, so that the zone is very rarely more hæmatoxyphil than the matrix of the cartilage above it. It can, however, be recognized by its hyaline appearance and a narrow dark line which defines sharply its upper border (*Fig.* 265). The upper limit passes sometimes above, sometimes through, and sometimes below the lower tier of columns. If often forms a zone free from cells beneath the columns. It is covered inferiorly in some sections completely by a horizontal deposit of lamellar bone, but in others there are a very few short wide primary medullary spaces which reach almost to the upper limit of the calcified cartilage. The summits of all but one are lined with osteoid tissue or bone; the sides are lined with bone, sometimes in a thick layer. In different sections from one to three slender trabeculæ of bone extend into the medulla.

In sections nearer the centre of the rib there is a similar zone of proliferation and provisional calcification at each side of the costochondral

junction; the zone is sometimes deeper than in the former sections, having three tiers of cells in clumps. The central third, however, of the junction is occupied by a descending tongue of cartilage, which is similar to that above the zone

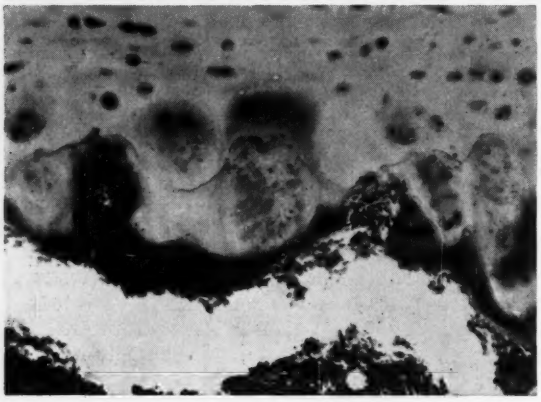

FIG. 265.—Left 5th rib: epiphysial junction. Zones of proliferation and chondral calcification; horizontal deposit of bone; two primary medullary spaces. (H. and E.) (× 75.)

of proliferation except that its matrix is pale and eosinophil, the halos are absent and the cells are scanty; its inferior margin is usually entirely free from cells (*Fig.* 266). In its upper part is a chondral canal containing five vessels. The zones of chondral proliferation and calcification end with a sharp line at each side of the base of the tongue. Several vessels, often at short intervals and usually accompanied by hæmatogenous marrow, extend up into it for a considerable distance. They thus form medullary canals which are lined by a layer of small flat osteoblasts, but show no deposit of bone or osteoid tissue. There are, however, several, usually deep, deposits of bone upon the lower margin of the tongue. In places the vascular channels extend laterally in the cartilage and so cut off partly or completely portions of the acellular cartilage, with or without bone on their inferior margins. A few small portions thus cut off lie in the medulla as deep as 3 mm. beneath the tip of the tongue and 5 mm. beneath the highest level of the lateral costochondral junction. Slender trabeculæ of bone extend both from this tongue and from the zones of proliferation on each side of it, but the greatest number in any section is five, the usual number being three.

Not only are the trabeculæ arising from all parts of the epiphysial line few and slender, but those throughout the medulla are very sparse and slender, while the cortex is thin, being 50 μ wide near the cartilage and expanding to 200 μ. Active osteoclastic resorption is present in one or two small areas beneath the periosteum. Evidence of former lacunar resorption is also seen on the outer surface of the corticalis, but there is no evidence of it in the spongiosa. The bone is everywhere lamellar, excepting a few small areas of woven bone in the corticalis (Schmorl's thionin stain). Adipose cells are scattered through hæmatogenous marrow, which preponderates greatly.

Endochondral ossification is thus proceeding in the rib, though very slowly. In the normal series there is a continuous zone of proliferation at 20 years, though the columns contain fewer cells and are much more widely separated than in the dwarf. At 26 years also there is a continuous zone of proliferation and a few primary medullary spaces in the centre and several in the lateral angles of the cartilage. At 24 years, however, although a zone of a few clumps and columns is present in the lateral parts of the cartilage it extends for only a little distance beneath the core (Zone V), the centre of the core being free. At 31 (two), 47 (two), and 59 years a zone of proliferation, represented by a few small clumps of cells is present only beneath Zone I to Zone IV, the lower part of the core containing cells typical of Zone V, and showing no trace of a proliferation zone. At 44, 51, and 66 there is no zone of proliferation. The complete cessation of typical endochondral ossification in a rib may not, therefore, have ceased at 59 years, but at 31 and later it only takes place laterally beneath Zones I to IV. That these zones remain capable in advanced old age of provisional proliferation, provisional calcification and endochondral ossification, whilst the core does not, is shown by Erdheim's description of the return of active endochondral ossification in his acromegalic patient of 77 years. The continuation of endochondral ossification in zones other than Zone V

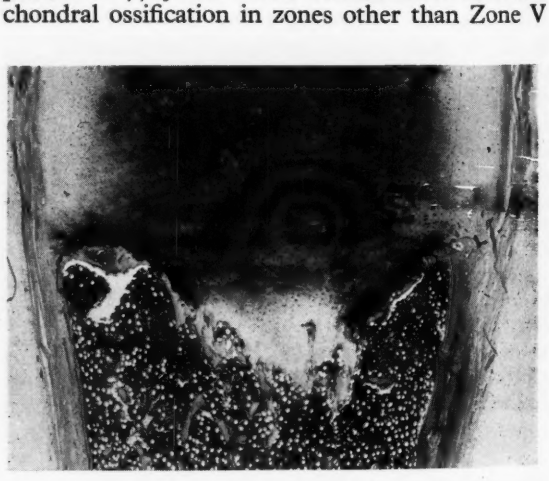

FIG. 266.—Left 5th rib: central degenerated tongue of cartilage. Transverse asbestos degeneration. (H. and E.) (× 10.)

causes the downward convexity of the end of the costal cartilage which is seen in the specimen at 20 years to become a long tongue in later years. But even at 20 and 26 years when there is a complete zone of proliferation, it is not so well developed as in the dwarf. It is difficult to understand why there is a tongue of degenerated cartilage free from preparatory changes in the

centre of the costochondral junction in the dwarf, because the core of Zone V does not form it as in the cartilages of normal subjects over 31, but it is a degenerated portion of the cartilage of the type of Zone III which extends right across the cartilage for 3 mm. above the epiphysial line. The degenerated tongue has been present for a long time because portions of it with bone upon them lie in the medulla 3 mm. below its tip. Bone is deposited upon it without provisional changes as happens in fissures and in degenerated cartilage round chondral canals in old costal cartilages, for instance, in the male of 44 in the normal series.

The rib is porotic, but there is no evidence of excessive lacunar absorption. The porosis is due to deficient deposition.

Humerus.—

Head and neck of right humerus: The section includes slightly more than the inner half of the head and neck. The cartilage of conjugation varies in depth from just under 1 mm. to 2 mm. In the bony *epiphysis* the zone of provisional calcification beneath the articular surface is deep and regular and encloses round and oval clumps of cells; on the upper surface of the cartilage of conjugation it varies greatly in depth, sometimes being very deep and at others shallow. There is no zone of proliferation outside it, though in the articular cartilage narrow spindle-shaped brood-capsules are present for a considerable distance above it. There is no evidence of active endochondral ossification. The inner surface of the calcified cartilage is almost entirely covered with a horizontal deposit of bone. From this bone slender trabeculæ pass to an interrupted and somewhat widely-meshed net of spongiosa. There is a very little hæmatogenous marrow, between adipose cells, in places beneath the articular surface; otherwise the marrow is entirely adipose.

Between the zone of chondral calcification towards the epiphysis and the zone of provisional proliferation for the *diaphysis* resting cartilage is in two areas some seven cells deep and elsewhere either one or two cells deep or entirely absent. The zones of provisional proliferation and chondral calcification for the diaphysis thus occupy almost the whole depth of the conjugating cartilage below the zone of chondral calcification of the epiphysis, and it is variations in the depth of the zone of provisional proliferation which cause the irregularity in the depth of this cartilage. In one place in several sections the zone of provisional proliferation increases more than threefold suddenly, so as to present a lateral border almost parallel to the long axis of the bone. In the shallowest portions only the upper parts of a single row of columns lie above the zone of provisional calcification, while in the deepest portion there are two or three tiers of columns. The columns are surmounted by two or three tiers of cells in clumps. In a small area near the neck the zone is shallow and appears normal, except that the cells within the single row of columns are separated by an abnormal amount of matrix, which is hæmatoxyphil and stained pink by Hoyer's method after removal of the celloidin. Elsewhere the matrix within the columns, and frequently also within the clumps, is greatly swollen and is stained either a deep or pale blue by hæmatoxylin and pink by Hoyer's method. This mucinous degeneration implicates

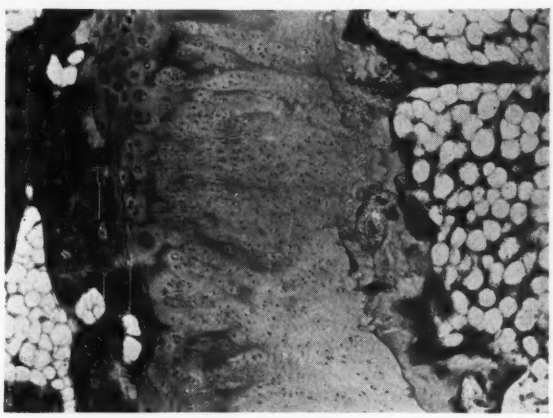

FIG. 267.—Humerus: cartilage of conjugation of head. Mucinous degeneration of deep zone of proliferation for diaphysis. Portions of two primary medullary spaces in zone of provisional calcification. (H. and E.) (× 33.)

to a varying degree the matrix between the columns and clumps, so that unaltered matrix is reduced to a variable number of slender trabeculæ stained blue by Hoyer's method. Extensive mucinous degeneration has led to softening, as is shown by the proliferation zone having been thrown into delicate parallel ridges by the microtome knife. Not only are the cells within the columns separated by the mucinous degeneration, but in the most affected areas very many have disappeared and those that remain are abnormally small. So great is the degeneration towards the centre of the bone that clumps and columns are no longer recognizable, but only a few small round and spindle cells lie in approximately vertical lines in an abundant mucinous matrix (*Fig.* 267). The depth of the zone of provisional calcification is in general considerable, but shows great variations. Its upper margin is extremely crenated, preceding vessels of which some have passed up far beyond others. As in the rib, decalcification of this zone has been carried too far, so that it is not stained deeply by hæmatoxylin; in lightly stained hæmatoxylin and eosin sections it is seen as a pale pink hyaline zone separated by a sharp line from the blue, mucinous cartilage above it (*Fig.* 267). The cells in the zone are hypertrophic, but they are usually very sparse. Many vessels, accompanied by interstitial tissue, pass at irregular intervals into the calcified zone and sometimes reach its upper limit. They tend to pass obliquely upwards and after a course which is usually short, branch approximately

transversely. They pass into the perpendicular border of the epiphysial line mentioned above at right angles to the long axis of the bone. Wide, irregularly directed primary medullary spaces are thus formed. Several are lined with bone, others with osteoid tissue, but a considerable number have no lining. Osteoclasts are a conspicuous feature, doubtless because the calcified cartilage contains so few cell spaces. Where vessels do not enter the calcified cartilage its diaphysial margin is covered with a horizontal layer of bone.

In addition to the mucinous degeneration of almost all the proliferative zone the sections show seven vertical areas of severe degeneration, necrosis, and partial colliquefaction of the cartilage. In some the margins are deeply hæmatoxophil, while the centre is crossed by deeply hæmatoxophil fibrils from the matrix, and the narrow spaces between these contain hæmatoxophil finely granular coagulum. In most the margins are eosinophil and the centre contains portions of pale eosinophil or hæmatoxophil, often vacuolated, acellular cartilage, separated by irregular clefts in which there are usually hæmatoxophil droplets of coagulum. The margins are ragged. Traced in different sections, most of these areas extend from the zone of chondral calcification of the epiphysis down to that of the diaphysis or to the layer of bone above the diaphysis. Vessels with interstitial tissue reach the lower extremity of 5, and in 2 of these bone is being deposited upon the lower margin of the degenerated cartilage. A plug of bone fills the lower end of another.

From the horizontal layer of bone bounding the calcified cartilage a few bony trabeculæ extend into the medulla, usually for a short distance. The trabeculæ in the medulla are slender and sparse. The width of the corticalis of the neck is about 200 μ at its greatest. Neither the trabeculæ nor the corticalis show evidence of lacunar absorption. A few shallow seams of osteoid tissue are present upon the horizontal layer of bone, but a search had to be made to find one on a medullary trabecula. The bone is lamellar, except a zone of woven bone beneath the periosteum of the neck and small areas of fine-fibrillated, slightly woven bone in the centres of trabeculæ. A conspicuous feature of the spongiosa of the diaphysis are trabeculæ expanded by large pieces of cartilage encapsulated by bone. One section contains seven. The largest is oval and measures 2·5 by 1·5 mm.; the top of the lowest is 7 mm. below the epiphysial line. The pieces of cartilage are calcified in the whole or part of their periphery; the calcified zones contain an occasional hypertrophic cell. Two are mucinous. Some contain resting as well as proliferated cartilage. In one the resting cartilage contains a stellate cleft with eosinophil margins. Active endochondral ossification is shown by a considerable number of vascular spaces entering their periphery, bordered sometimes by a seam of osteoid tissue and sometimes by a layer of bone. The marrow is almost entirely adipose. Patches of hæmatogenous marrow, forming a network between fat cells, are most numerous in the metaphysis.

Summary and remarks: Endochondral ossification appears to have ceased in the bony epiphysis. In the diaphysis it is still active. Here primary medullary spaces are more numerous than in the rib, and fewer have deposits of bone upon them. They are, however, very sparse in comparison with normal active endochondral ossification. The entering vessels are not only very irregularly spaced but their course and the level they reach are most irregular. The cartilage of conjugation shows two kinds of degeneration. One is a mucinous degeneration which is confined to the zone of provisional proliferation towards the diaphysis, and is slight only where this zone is shallow. Similar mucinous degeneration is one form of retrogressive change which in renal rickets affects the long segmented tongues and more widely separated islands of proliferated cartilage which have not been invaded by vessels. The other form is the transformation of the proliferated cells, of which the great majority are hypertrophic, into small cells resembling those of resting cartilage. This form occasionally occurs in the tips of broad tongues in nutritional rickets (Turnbull, 1932). In the present case the second form is absent, but the cells in the columns have become small in the more severely mucinous areas. Where, however, capillaries have come close to, or have entered, the mucinous cartilage, the cells have become hypertrophic, and, later, chondral calcification has taken place. Both forms of retrogressive change in renal rickets are doubtless due to the proliferated cartilage being left for a long time without permeation by vessels from the diaphysis. There is no question of any rickets in this case, but the mucinous degeneration is presumably due to the same cause. This is surprising, because in retarded growth the zone of provisional proliferation is not formed as in rickets in normal amount at the normal rate so that it accumulates, but deficiency in its formation is the chief cause of retardation of endochondral ossification. Apparently invasion by vessels in the present case has in the greater part of the cartilage lagged behind the diminished provisional proliferation. The second kind of degeneration in the cartilage of conjugation is the formation of vertical areas of asbestos and kindred degeneration, which pass right through the cartilage from the zone of calcification belonging to the epiphysis to that of the diaphysis or to the horizontal layer of bone bounding the diaphysis. Such degeneration is very frequent in senile costal cartilages. Its cause is distinct from that of the mucinous degeneration. It is due to the long exposure of the cartilage of conjugation to stress and strain, and possibly also to its age. Endochondral ossification is extremely irregular, as is shown by the great

variation in the depth of the hypertrophic zone and by the remarkably large portions of cartilage in otherwise slender trabeculæ in the medulla. The depth to which these masses of cartilage reach in the medulla shows that this irregularity has been present for a long time. The irregularity is explained by the irregularity in the distribution of the capillaries forming primary medullary spaces, the variation in the height to which they pass, the obliquity of their course and their transverse branches. In senile chondral cartilages degeneration can lead to clefts along which ossification can extend without provisional calcification. It was suspected that a similar ossification of the vertical areas of degeneration in the cartilage of conjugation might play a part in the irregularity of endochondral ossification, but no evidence was found of this. Clear clefts had not been formed. Vessels reached the lower border of some of the areas of degeneration and bone was deposited, but such ossification did not extend as high as true endochondral ossification about several of the vessels traversing the mucinous cartilage.

The humerus, like the rib, is porotic owing to osteoblastic inactivity and not to absorption.

H. M. T.

SUMMARY

A case of hypophysial-duct tumour, in a man of 43, with a protean symptomatology, is recorded. Infantilism, inhibited growth, retardation of age-changes in chondral cartilage, arrest of sexual development, diabetes insipidus, disturbance of carbohydrate and fat metabolism and of heat regulation, a subnormal basal metabolism, symptomatic narcolepsy, and mental changes, are described; their localization and significance, as shown by experimental, clinical, and pathological evidence, are discussed.

We are indebted to Professor J. R. Marrack, Chemical Pathologist to the London Hospital, for biochemical estimations; to Dr. C. E. Brunton for basal metabolic data; to Drs. M. H. Jupe and G. Vilvandre for radiological reports; and to Professor H. M. Turnbull and Dr. D. S. Russell for the pathological descriptions.

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A CASE OF LYMPHADENOID GOITRE ASSOCIATED WITH THE FULL CLINICAL PICTURE OF GRAVES' DISEASE*

By K. C. EDEN

SURGICAL REGISTRAR TO UNIVERSITY COLLEGE HOSPITAL, LONDON

AND W. R. TROTTER

ASSISTANT TO THE MEDICAL UNIT, UNIVERSITY COLLEGE HOSPITAL, LONDON

THERE is still much speculation concerning the nature of lymphadenoid goitre (Hashimoto's thyroiditis, struma lymphomatosa) and its relation to thyrotoxicosis and to Riedel's thyroiditis. Eason (1928) and more recently Vaux (1938), on clinical and pathological evidence, have expressed the opinion that all three conditions are closely related, and Polowe (1934) has supported this idea by an account of a case showing the clinical features of Graves' disease combined with the pathological picture of lymphadenoid goitre. There has, however, been much opposition to this view; Joll (1939), for instance, in a recent exhaustive study of Hashimoto's thyroiditis has stated: "There is nothing in the series of cases under review to confirm Eason's view that struma lymphomatosa and Riedel's disease are late developments in a thyrotoxic type of goitre. Since 1928, when Eason raised the question, I have taken pains to inquire into this possibility in all such cases, with consistently negative results". Joll is clearly of the opinion that lymphadenoid goitre is a disease *sui generis*, having no connexion with either thyrotoxicosis or Riedel's thyroiditis.

In view of this difference of opinion, the following case is important, because it provides undeniable evidence of the association of lymphadenoid goitre with the full clinical picture of Graves' disease.

CASE REPORT

HISTORY.—A widow of 56 years of age was admitted to University College Hospital under the Medical Unit on March 18, 1941. Her complaint was of a swelling in the neck and general ill health for three months. Seven years previously her husband died and she had never really been well since. At that time she lost 2 st. in weight, but picked some of it up again. Three years before admission she suffered a nervous breakdown accompanied by further loss of weight, swollen ankles, and invalidism. Subsequently she improved a little, but became worse again three months before admission, when she noticed the swelling in the neck. There was no history of a goitre earlier in life or of goitre in the family. She had never been treated with iodine.

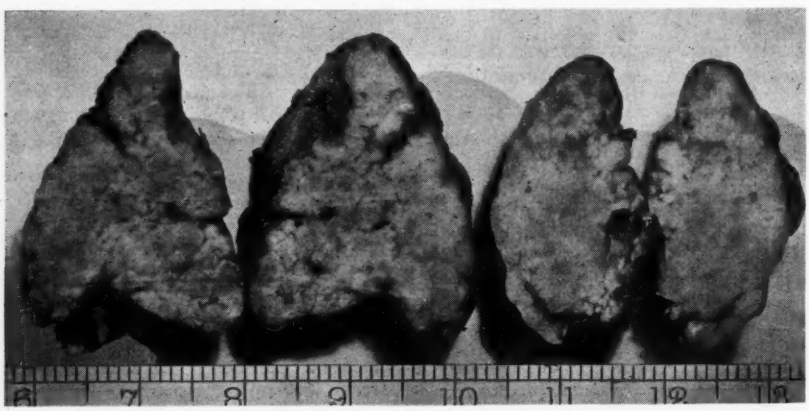

FIG. 268.—Cross-section of the two lobes of the thyroid gland removed at operation. The cut surface is white and opaque, with islets of pink hyperplastic glandular tissue.

ON EXAMINATION. The general appearance of the patient was characteristic of Graves' disease in an elderly subject, with well-marked generalized muscular wasting. There was moderate enlargement of the whole thyroid gland, the right lobe being somewhat larger than the left. On palpation it was firm and mobile and non-pulsatile. In a radiograph the trachea was seen to be displaced slightly to the left, but not compressed. There was bilateral lid retraction of moderate degree, but no exophthalmos or ophthalmoplegia. Von Graefe's sign was positive in each eye and there was considerable lax swelling of both upper and lower lids. Tremor of the outstretched hands was absent, although there was a good deal of

* From a clinic for the study of thyroid disease set up by the Medical and Surgical Units, University College Hospital, in March, 1938.

irregular movement of the fingers. The heart was moderately enlarged (confirmed by a radiograph), with a blowing systolic murmur at the apex and auricular fibrillation at a rate of 90–100. There was about 2 in. of venous congestion in the veins of the neck, but no other signs of congestive cardiac failure were present. The blood-pressure was 110 systolic, 75 diastolic.

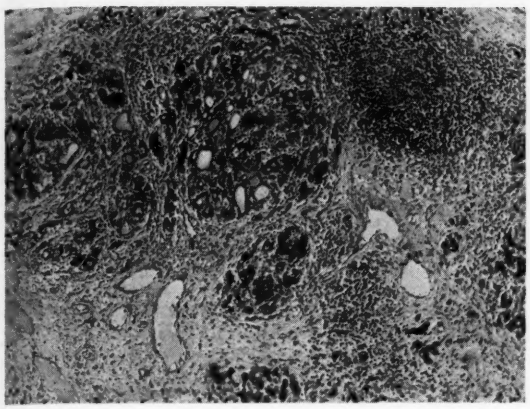

FIG. 269.—Low-power view of a section of the gland, showing destruction of thyroid tissue by diffuse lymphatic infiltration and fibrosis. (H. and E.) (× 56.)

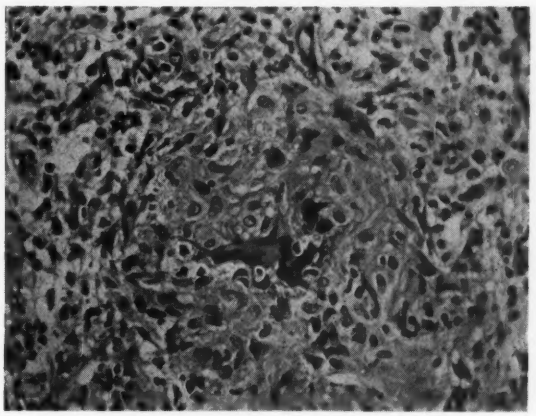

FIG. 270.—High-power view showing endothelial-celled system and a foreign-body giant cell. (H. and E.) (× 145.)

The skin everywhere was warm and moist, with a slight degree of generalized pigmentation. An early degree of localized nodular myxœdema was present in the skin of the pre-tibial region of both ankles, the diagnosis in this case being confirmed by skin biopsy (Freudenthal).

The basal metabolic rate was estimated on three occasions by the Benedict-Roth method, the results being + 48 per cent, + 44 per cent, + 39 per cent.

TREATMENT.—The case was regarded as one of straightforward Graves' disease in an elderly subject and she was given three weeks' rest in bed with digitalis and an eight-days' course of Lugol's iodine (min. x. t.d.s.) before operation. Two-stage thyroidectomy was performed by Professor R. S. Pilcher, the right lobe of the gland being removed first and the second lobe a week later. Both lobectomies were complete.

PROGRESS.—Following operation recovery was rapid, the lid retraction disappeared and the patient felt steadier and more composed. Auricular fibrillation persisted until three weeks after operation when a course of quinidine treatment was commenced (gr. 6, 4-hourly for one day; gr. 9, 4-hourly for the second day). On the evening of the second day the heart rhythm returned to normal and has remained so ever since without further quinidine treatment (confirmed by an electrocardiogram). The basal metabolic rate at this time was − 6 per cent, when she was discharged from hospital.

The patient has been seen since at regular intervals at the Thyroid Clinic and has maintained her improvement. Four months after operation, a slight degree of myxœdema was developing and thyroid medication was started. Eight months after operation her myxœdema was satisfactorily controlled on thyroid extract, 1 gr. twice daily, and the localized myxœdema was undergoing spontaneous involution. The auricular fibrillation had not returned.

THE SPECIMEN.—The gland removed at operation weighed 121 g. It was firm, smooth, and lobulated on its surface, being well encapsulated and free from adherence. The whole gland was uniformly enlarged and there was a well-marked retrotracheal extension on each side. The cross-section (*Fig.* 268) showed an opaque, white, fibrous structure with coarse lobulation and little islets of pink hyperplastic gland tissue bound up in the fibrosis. All parts of the gland were similar in appearance including the lateral lobes, the isthmus and the pyramidal lobe.

Sections were cut from many parts of the gland and stained with hæmatoxylin and eosin, Van Gieson's stain, and by the Ziehl-Neelsen method. The general appearance of the gland on section was of widespread destruction of thyroid tissue with lymphatic infiltration and fibrosis and areas of epithelial hyperplasia. In addition, there were many giant-celled systems giving the appearance of miliary tuberculosis. The lymphatic tissue was in two forms, partly as large mature follicles with well-marked germinal centres, and partly as a diffuse lymphocytic infiltration of the gland. Most of the lymphatic follicles were grouped between the lobules of thyroid tissue, but much of the lymphatic infiltration permeated between the individual vesicles. Wherever the lymphatic

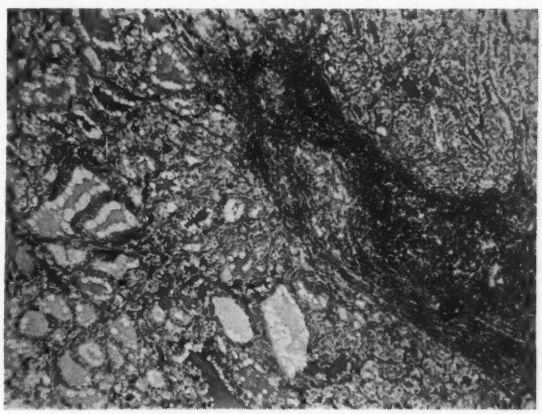

FIG. 271.—Low-power view of a part of the gland where there is still much intact glandular tissue. There is well-marked epithelial hyperplasia adjacent to a collection of lymph-follicles. (H. and E.) (× 56.)

tissue was extensive there was evidence of breaking up of the thyroid vesicles and fibrosis (*Fig.* 269). Some of the degenerating vesicles contained epithelial plugs and traces of colloid, others had no colloid and the lining cells were running together to form irregular syncytial masses.

The gland was split up into coarse lobules by dense strands of mature fibrous tissue, but many of the lobules were themselves fibrosed. There was widespread intralobular fibrosis, with young fibrous tissue in whorls replacing areas of glandular tissue. Many of the blood-vessels showed evidence of thickening.

The giant cells were to be found in relation to the whorls of endothelial cells and young fibrous tissue (*Fig.* 270). Some of them were like tuberculous giant cells in appearance, but others were plainly of the foreign-body type, elongated or crescentic in shape, with a central group or an irregular row of nuclei and vacuolated cytoplasm. Some of these cells contained small fragments of transparent matter engulfed in the cytoplasm.

Wherever there was intact glandular tissue, epithelial hyperplasia was well marked, with infolding of the walls of the vesicles, reduction in the colloid and only a moderate degree of lymphatic infiltration as in the gland in Graves' disease (*Fig.* 271).

Sections of the gland stained by the Ziehl-Neelsen method failed to show tubercle bacilli.

Dr. D. M. Vaux and Professor G. Hadfield have both examined the sections of the gland and have expressed the opinion that it is an example of Hashimoto's thyroiditis associated with hyperplasia of the glandular tissue.

DISCUSSION

It is not proposed here to do more than record this case as an example of the association of thyrotoxicosis and Hashimoto's thyroiditis in the same patient. The evidence of thyrotoxicosis was based on such reliable criteria as the presence of lid retraction and otherwise unexplained auricular fibrillation, and by a consistently raised basal metabolic rate. The diagnosis was confirmed by the response of the patient to thyroidectomy, including the abolition of the lid retraction and the auricular fibrillation. It is clear that such a typical case of Graves' disease cannot be dismissed as a slight toxic reaction to the thyroiditis, which Joll admits may occur in the early stages of Hashimoto's disease.

It is equally evident that the pathological picture cannot be classed as that of the common lymphatic type of toxic diffuse goitre, for the lymphatic infiltration, fibrosis, and destruction of thyroid tissue are fully as great as in classical examples of Hashimoto's thyroiditis. The giant cells are a recognized, though unusual, feature of lymphadenoid goitre; Vaux's series contained two typical examples in which such cells were abundant. Olper (1935) believed that their function is to remove by phagocytosis the colloid which, owing to the widespread destruction, is unable to escape by the usual channels. Goetsch (1940), however, has since expressed the opinion that the colloid particles become engulfed accidentally in the syncytium of epithelial cells during their coalescence.

There can only be two interpretations of this case: either it represents the fortuitous concurrence of two disease processes—thyrotoxicosis and Hashimoto's thyroiditis—in one and the same thyroid gland; or else the pathological picture which goes by the name of lymphadenoid goitre is no more than an exaggeration of the lymphatic infiltration commonly found in toxic diffuse goitre. In either case, it is remarkable that such widespread destruction of the thyroid can be associated with well-marked signs of thyrotoxicosis.

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MONTEGGIA FRACTURES

By ARTHUR NAYLOR
RESIDENT SURGEON, E.M.S., BRADFORD

SINCE Monteggia[1] in 1814 described 2 cases of fracture of the upper third of the ulna associated with dislocation of the head of the radius, this particular lesion has been known as Monteggia's fracture. Despite its comparative rarity, it is important because of the frequency of overlooking the radial dislocation and the economic loss resulting from this omission.

INCIDENCE

Wilson[2] had only 3 cases in a series of 439 elbow injuries, whilst Cunningham[3] had 14 in a series of 257 cases of fracture of the shaft of the ulna. As the latter series, however, specifically excluded fracture of the olecranon and styloid process, the true incidence is not so high as suggested by Cunningham.

Of the present series of 9 cases, 8 were treated at the Fracture Clinic of the Sheffield Royal Infirmary, where 3,500 cases with fracture are treated annually. These 8 cases occurred during a period of two years, when 322 fractures in the region of the elbow were treated (274, if olecranon fractures are excluded).

MECHANISM

The common type of Monteggia fracture is a fracture of the upper third of the ulna, 3 in. or 4 in. below the tip of the olecranon process, associated with the anterior dislocation of the head of the radius (*Fig.* 272).

FIG. 272.—Radiograph of typical Monteggia fracture.

This is due to direct violence applied to the ulna which continues to force the lower ulnar fragments forwards. The latter pulls on the radius by means of the interosseous membrane, and this force is counteracted by the orbicular ligament of the superior radio-ulnar joint. The interosseous ligament is stronger than the orbicular ligament, and therefore the latter must rupture and allow dislocation of the head of the radius. This type of lesion occurred in 6 of the 9 cases studied. The ulnar fragments are usually angulated forwards and towards the radius. The supinator brevis probably maintains the upper fragment in this position. In all the cases of this series the ulnar fracture is at this typical position. Occasionally the ulna may fracture at its lower one-third or mid-shaft; this is more liable to be accompanied by fracture of the shaft of the radius than by dislocation of the radial head.

Occasionally the head of the radius is dislocated laterally (*Fig.* 273).

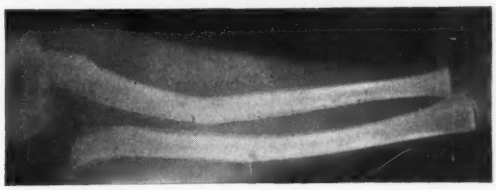

FIG. 273.—Radiograph showing lateral displacement of the head of the radius.

This occurred in 2 of the 9 cases under review. Brief details of one of these are given below :—

Case 1.—B. S., aged 4, was admitted on March 5, 1940, with a history of falling from a cycle.

X-ray Examination showed a fracture of the upper third of the right ulna with lateral dislocation of the head of the radius.

TREATMENT.—Reduction under general anæsthesia by manual traction. Elbow fixed in mid-pronation and at right angles.

April 2, 1940: Plaster removed, union sound.

April 23, 1940: Full function present.

In these cases, the ulnar fragments are not greatly displaced, and the radial dislocation is most probably due to direct violence applied to the radial head rather than by transmission through the interosseous ligament.

Rarely the violence is applied anteriorly. The ulnar fragments are then displaced backwards, and the head of the radius is dislocated posteriorly by the pull of the interosseous ligament. Only 1 example was encountered in this series of cases.

Indirect violence has been said to be the cause of these lesions, but such violence usually causes fracture of the head of the radius without any coincident fracture of the upper third of the ulna. The ulnar fracture is always transverse in type, which can scarcely be said to be due to indirect violence. Again there is considerable bruising at the site of the ulnar fracture, which in a large proportion of the cases is compound.

SYMPTOMS AND SIGNS

The lesion occurs most frequently in children aged from 5 to 7 years, and is due to a blow or a fall on to the elbow or upper forearm.

Case 2.—M. N., aged 5, was admitted on Oct. 10, 1940, with a history of falling on to the left forearm.

ON EXAMINATION.—There was a wound on the anterior aspect of the forearm.

X-ray Examination showed a fracture of the upper third of the ulna, with anterior dislocation of the head of the radius (*Fig.* 272).

TREATMENT.—Wound excised and sutured under general anæsthesia. Reduction by manual traction with the elbow in mid-pronation and flexion, with pressure applied to the head of the radius, and fixation in plaster-of-Paris with elbow at right angles and mid-pronation.

PROGRESS.—

X-ray Examination.—One week later showed position to be satisfactorily maintained (*Fig.* 274).

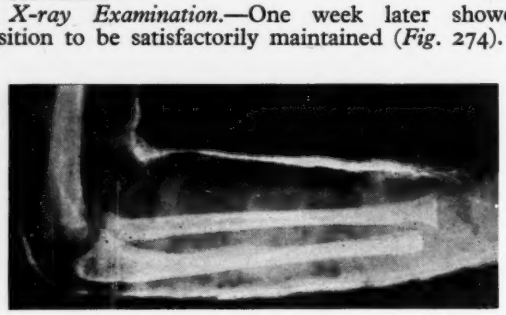

FIG. 274.—*Case* 2. Radiograph taken one week after treatment, showing the position of the fragments to be satisfactorily maintained.

November 21, 1940: Plaster removed. *X-ray Examination* showed firm union of the ulna, and the head of the radius in perfect position.

December 5, 1940: All movements normal except slight limitation of pronation.

The arm is held in partial flexion at the elbow, and there is usually marked swelling and bruising around the joint. The head of the radius may be palpated anterior to the lower end of the humerus, whilst depression can often be noted behind and below the external condyle in early cases, before swelling obscures the bony landmarks. Pronation and supination are usually impossible because of pain.

Radiographs revealing displacement of a fragment in a fracture of the upper third of the ulna should always focus attention upon the head of the radius, because such a lesion must be associated with disturbance of the superior radio-ulnar joint.

COMPLICATIONS

In this small series of cases, one-third were compound, a complication which one would expect with lesions following direct violence.

An equally common complication is fracture of the dislocated radial head. This is usually of the marginal type, with displacement[4], and is due to the direct impact of the posterior part of the radial head against the capitellum. One example of this lesion was encountered.

The proximity of the posterior interosseous nerve to the neck of the radius would lead one to expect a radial nerve palsy as a complication. This was present in one case in the series, where dislocation of the head of the radius had not been recognized for three days. Reduction of the radial displacement is usually sufficient to allow recovery.

Case 3.—C. P., aged 23, was admitted to another hospital on July 8, 1940, with a fracture of the upper third of the ulna. The arm was fixed in plaster-of-Paris, without the dislocation of the radial head being discovered. When seen at the Fracture Clinic the true nature of the lesion was detected. It was complicated by a posterior interosseous paralysis. Reduction was performed by manual traction, with the elbow in mid-pronation and flexion.

October 4, 1940: All movements full except extension, which was limited to 100°—paresis still present.

November 15, 1940: Extension limited to 130°—other movements full—paresis recovered.

February, 1941: All movements complete.

Non-union of the ulnar fracture is very liable to occur in a Monteggia fracture, although this did not complicate any of our cases. It is probably due to the radius acting as a splint to prevent firm apposition of the ulnar fragments. Another factor is the constant tendency of the ulnar fragments to angulate forwards and laterally even when the radial dislocation is reduced.

TREATMENT

Recent Cases.—The number of methods of treatment suggested reflect the difficulty of securing and maintaining reduction, and imply that no single method can be successfully applied to all cases.

Wilson[2] and Henderson[5] advocate open reduction of the radial displacement, suture of the orbicular ligament, and fixation of the limb in a position of flexion and supination; but this is not required so frequently as these writers suggest.

Manual traction, or traction by means of finger-stall grips in a traction apparatus, and application of a plaster cast with the elbow-joint fixed at right angles and pronated, was attempted in all cases, and was successful in the majority of uncomplicated cases. Although reduction is usually obtained in this manner, maintenance may be impossible. In 2 cases the reduction was obtained and maintained by fixing the elbow in flexion and supination, and this method is usually successful with all cases except where there is posterior dislocation of the radius.

Case 4.—S. S., aged 25, was admitted on Aug. 11, 1938, suffering from multiple injuries.

ON EXAMINATION.—Multiple injuries included a fracture of the upper third of the left ulna, with a dislocation of the head of the radius.

TREATMENT.—Reduction of dislocation of the fracture by manipulation and fixation, inflexion and full supination by means of a plaster strip. Collar-and-cuff applied.

PROGRESS.—

November 22, 1938: Extension of elbow, 160°. All other movements full.

Unfortunately, angulation of the ulnar fragments is prone to result in this position, and open fixation of the ulna may be necessary. Repeated attempts at closed reduction should not be made, as this is very liable to result in marked restriction of movement later. In this series manipulative methods only failed on two occasions.

If manipulation fails, as it is not very prone to do, owing to fragments of the orbicular ligament being pushed backwards by the radial head, or to the fact that reduction cannot be maintained because of this same ligamentous obstruction, open reduction of the radial dislocation should be attempted, followed by fixation of the elbow in a plaster cast in mid-pronation and at right angles, after traction in this position. This is usually sufficient to allow reduction of any ulnar displacement, but open fixation of the fragments will have to be performed if displacement still persists.

The combined approach through a posterior incision described by Speed and Boyd,[8] while excellent anatomically, will probably be followed by restricted function because of the extensive trauma to the peri-articular structures. Separate approaches are, therefore, to be preferred.

Fixation of the ulna by means of a bone-graft is to be preferred to fixation by means of vitallium plates and screws, as the risk of non-union is thereby greatly reduced. The intramedullary Kirschner wire method of fixation introduced by Lambrinudi[9] offers a much simpler solution of the problem, but no cases were encountered where the method could be introduced.

Early open reduction for uncomplicated cases is advocated and performed with much greater frequency in North American Clinics than in this country. This method is to be discouraged. In our experience closed reduction can be obtained in the majority of cases by means of Böhler's method, and failing this fixation in flexion and supination.

Again, there is a tendency to stress operative repair of the orbicular ligament in recent cases. This is unnecessary when accurate reduction of the radial head is obtained. In not one of this series was any attempt made to repair the orbicular ligament, and the functional results obtained fully justify this.

Posterior dislocations should be maintained by fixation of the elbow in full extension and supination.

Case 5.—M. B., aged 51, was admitted on Jan. 22, 1940, with a history of falling on the right elbow.

X-ray Examination revealed a fracture of the ulna and head of the radius, with posterior dislocation of the head of the radius (*Fig.* 275).

TREATMENT.—Traction on Zimmer apparatus and manipulation. Full arm cast applied.

X-ray Examination showed dislocation reduced, but still 15° of angulation of the ulnar fragments.

February 7, 1940: Operation under general anæsthesia. Incision over upper end of ulna. Fracture exposed and good position obtained with elbow extended and supinated. Wound closed, and plaster cast applied with arm in this position.

FIG. 275.—*Case* 5. Radiograph showing the fracture of the ulna and head of the radius, with posterior dislocation of the radial head.

February 8, 1940: X-ray examination showed good alinement and apposition of the ulna.

April 16, 1940: Flexion 85°, extension 155°, supination limited by 30°, pronation by 90°.

June 11, 1940: Full flexion, extension 160°, supination full, pronation limited by 15°.

Where fracture of the radial head complicates the injury, open reduction associated with excision of the radial fragments should be an immediate measure, followed by the reduction of the ulnar fracture by means of traction with the elbow in mid-position. Excision of the radial head in uncomplicated recent cases is to be condemned, especially in children, where growth will be interfered with, followed by cubitus valgus with late ulnar neuritis. In children reduction of the radial dislocation is all important, and slight ulnar deviation can be ignored if this reduction is perfect. The method of fixation in flexion and supination is, therefore, excellent for these cases.

Old Cases.—Old unreduced cases are characterized by pain, instability, and restricted movement, especially pronation and supination. They are not common. Flexion is usually limited by the bony block arising from the malunited ulna or the dislocated head of the radius. Excision of the head of the radius in such cases in adults will often effect an improvement in function and the reduction of pain. In some cases angulation of the ulna may be corrected by osteotomy, and dislocation of the radial head then reduced. This reduction must be maintained by constructing a new orbicular ligament from the bicipital fascia[6], or by using a free transplant from the palmaris longus,[7] or the

method of repair and fixation of Speed and Boyd,[8] which is specially suitable for these cases. As non-union of the ulna is usually due to the radius preventing firm apposition of the ulnar fragments, a first measure in treating this complication in older subjects should be excision of the head of the radius. The ulnar fragments could then be fixed in good alinement and apposition, preferably by means of a bone-graft.

In old cases of non-reduction in children the chief disability is the visible deformity. Function is usually good, and any operative interference to improve the appearance in such cases is to be condemned. Excision of the dislocated radial head is liable to be followed by increased cubitus valgus. Any defective function should be treated by intensive physiotherapy and operative treatment is to be avoided as much as is possible. Where function is very poor, and in girls where the appearance is of importance, Speed and Boyd's method of fixation and repair is likely to effect an improvement.

RESULTS

A search through available literature leaves one with the impression that full function following a Monteggia fracture is a rarity. Although one should not be too optimistic when reviewing a small series of cases, the results of those described tend to dispel this idea. The average disability period for the whole of the series was fifteen weeks, and only eight weeks in those occurring in children. They show that extension and supination are the movements which are recovered with difficulty, and that late reduction is a factor producing restricted movement. Four cases had complete function restored, and in 1 all movements except slight limitation of pronation. In 3 cases extension was limited to 130°–160°. American workers stress the importance of ulnar alinement in determining the amount of rotation obtained. Yet in our cases, where rotation was impaired, ulnar alinement was very good. The least satisfactory result was obtained where open reduction and plating followed repeated failures to obtain closed reduction.

One is impressed by the good results obtained in children, and where closed reduction is obtained early. Despite transatlantic tendencies in the opposite direction, one feels that better results of the treatment of Monteggia fractures are to be obtained by early recognition of the radial dislocation and its reduction by closed methods with a minimum of peri-articular trauma, rather than by devising operative procedures to produce accurate anatomical alinement of the ulna and repair of the orbicular ligament.

SUMMARY

1. The clinical aspects of Monteggia fractures are discussed.

2. The importance of recognition and early treatment of the radial dislocation is emphasized.

3. Methods of treatment are discussed, and stress laid on the value of conservative methods of reduction as opposed to methods advocated by transatlantic workers.

I wish to thank Mr. F. W. Holdsworth for his kind permission to study these cases; and Mr. R. G. Taylor for his assistance in obtaining some of the records.

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TISSUE INFILTRATION BY CHOLESTEROL AS A RESULT OF TRAUMA

By A. E. MORTIMER WOOLF

SENIOR SURGEON TO QUEEN MARY'S HOSPITAL FOR THE EAST END; SURGEON TO THE E.M.S.

Deposit of cholesterol crystals in the tissues, as a result of hæmatomata, must be an unusual occurrence, and little is to be found about it in the literature. The recording of 2 such cases seen within a year may, therefore, be of interest.

In a search through the literature of this condition, I have been unable to discover a single recorded case of cholesterol deposit in the tissues, apart from its presence in some of the closed cavities of the body, such as the pleura. Wells,[1] in his *Chemical Pathology*, when describing the fate of hæmatomata, merely mentions that cholesterol crystals may be deposited. He points out that the central mass of the hæmatoma is not soon, if ever, invaded by leucocytes or tissue cells. Therefore, the encapsulated blood is only slowly acted upon by the enzymes liberated by the leucocytes, and the products of decomposition are only slowly absorbed. He also points out that the least soluble constituent of red corpuscles is cholesterol, and that this substance may accumulate in such extravasations "as large, thin plates; after most of the other products of disintegration have been absorbed from such accumulations of blood, the most conspicuous part of the residue may be a mass of cholesterol crystals embedded in proliferating connective tissue or giant cells."

The facts of the two cases here recorded bear out this statement, though it is a matter for astonishment that more examples have not been found in the literature.

CASE REPORTS

Case 1.—W. J. F., aged 58.

History.—This man sustained a bayonet wound in the upper part of the left thigh during the last war. For many years he had noticed a swelling in the thigh, which he had been told was a "cyst". Eight weeks before his admission to hospital (Feb. 12, 1940) the cyst "ruptured". He had sudden pain in the thigh and was seen by Dr. Wells, of Royden.

On Examination.—There was some general swelling of the thigh, and the tissues felt hard and indurated. There was no definite localized swelling, but it appeared to be impossible to palpate the deeper tissues, owing to a strong barrier, especially marked over the front of the extensor muscles. The radiograph showed shadows on the outer and front aspects of the thigh. The appearance resembled either bony or calcifying lines not in connexion with the bone, but infiltrating the muscle. These lines were short, some of them transverse, some oblique, and some vertical (*Fig.* 276). As regards diagnosis, the question of myositis ossificans was raised, and also the possible question of sarcoma. There were obvious objections to both these diagnoses, which need not now be discussed.

At Operation.—An incision was made into the swelling towards the lateral aspect of the thigh. At first nothing abnormal was discovered. On exploring

Fig. 276.—*Case* 1. Radiograph showing shadows in the outer and front aspects of the thigh (*see* text).

the tissues with the finger, they felt hard and indurated, and towards the middle of the thigh, an incision into this indurated area released white fluid, which was thought to be pus. This was examined immediately by the late Dr. Kerridge, who reported that the fluid consisted of pure cholesterol crystals. The wound was packed lightly. It did not heal, and a serous-like discharge continued.

Three weeks later the wound was again explored, and a large portion of the anterior sheath of the rectus

was excised. This was hard and stiff, and in places one could almost have scratched one's finger on it. Quite a large area was removed. The wound was now sutured. For a long time a small sinus persisted, with some serous discharge, but eventually this stopped and the wound has remained healed.

When seen one year later, the man was perfectly well, and his thigh appeared to be normal, although the radiograph still showed areas similar to those in the first X-ray examination. In fact, both radiographs were very similar in appearance.

THE SPECIMEN.—Dr. Gloyne kindly examined microscopically the tissues removed, and reported as follows: "A mass of collagenous tissue containing small blood-vessels with thickened walls. In places tissue still cellular; other parts of tissue show hyaline degeneration. No calcium deposits noted. No cholesterol crystals seen. No evidence of malignant disease or tuberculosis. Fluid full of cholesterin crystals. Appearance suggests an old healed traumatic lesion."

A cholesterol content of the blood, kindly estimated for me by Professor Marrack when the patient was last seen, i.e., one year after the operation, shows 160 mg. per 100 c.c., well within the range of normality.

Case 2.—G. E. S., aged 57.

HISTORY.—This man was kicked by a cow on the right side of the scrotum three weeks before admission to hospital. He is definite in his statement that he could find nothing wrong with his scrotum before the injury, and no amount of cross-examination has been able to shake him on this point. On the other hand, in the left testicle there is a spermatocele, obviously of long standing, of which he was unaware.

FIG. 277.—*Case* 2. Drawing of the scrotal cavity, showing the infiltration of the walls with crystals.

ON EXAMINATION.—Within the scrotum was a hard mass, nodular, almost of bony consistence; it was not translucent. Diagnosis rested between a hæmatocele, with great thickening, and possibly malignant disease. There was, however, no thickening of the cord; there was no evidence of any disease apart from the scrotum.

AT OPERATION.—On incising the scrotal tissues, which were very thick, immediately a white, glistening material, very similar to that described in the first case, was obtained. In view of my previous experience, I recognized this fluid as containing cholesterol crystals, and this was confirmed by microscopical examination. On inserting the finger into the cavity of the scrotum, I very nearly scratched it against the wall, which was infiltrated with crystals, as shown in the drawing (*Fig.* 277). Very little testicular substance remained. The coats of the scrotum were, however, thickened, and appeared to be one hard mass. They were easily enucleated from the skin, and, together with the remains of the testicle and the cord, were removed as one specimen (*Fig.* 277).

Healing was uneventful, and the man was discharged from hospital three weeks after operation.

Professor Marrack very kindly did a serum-cholesterol estimation, which shows a figure of 225 mg. per 100 c.c. This, though again within the range of normality, is definitely high. Of course, it is absurd to think that this condition could have come on within three weeks. The specimen gives one the impression that this cholesterol infiltration has taken a long time to develop. Nevertheless, the man, who was very intelligent, refuses to budge from his statement.

DISCUSSION

In a paper on "Cholesterol Pleural Effusion" by H. H. Moll and F. S. Fowweather,[2] a case is recorded of pleural effusion, in which the fluid contained numerous cholesterol crystals. It also contained blood. Aspiration was carried out and the man was discharged, but he was readmitted with recurrence of hæmorrhagic pleural effusion in which again cholesterol crystals were found. The authors of this paper point out that one of the features of cholesterol pleural effusions is that they are often encysted and associated with marked pleural thickening. This would seem to be comparable with my case of the man who was kicked in the scrotum.

It is not my intention here to enter into academic discussion as to why cholesterol is deposited in some cases and not in others; indeed, I am hardly competent to do so, but Moll and Fowweather quote Desbordes and Lévy, who have noted in general that fresh effusions contain less cholesterol than old, though apparently in pleural effusions this is not invariably the case. Desbordes apparently believes that there is a constant change in the cholesterolytic power of fluids with age. That is to say, the older the fluid, the more cholesterol it contains. Some fluids, usually fresh ones, seem to have the power of dissolving the cholesterol, while others, the more aged, precipitate it. The authors also state that precipitation of cholesterol only takes place when such old fluids come into contact with solid cholesterol. Therefore, presumably, crystals have to be deposited in the first place.

Whether the above is true of the ordinary tissues, as apart from the pleura, I cannot say, but it is difficult to see how this theory will explain the deposit of cholesterol in my first case, in which there was no effusion in the sense of a collection of fluid in one of the natural cavities of the body, although it is interesting to note that in the patient's history a cyst had formed and had "ruptured". In the second case, which occurred in the scrotum, the comparison with a pleural effusion is more apparent, but at operation the whole of the tunica vaginalis was one mass of these crystals, which were also infiltrating the tissues between the tunica vaginalis and the skin.

It is intended to present the specimen of the scrotum to the Museum of The Royal College of Surgeons.

Both these cases were seen and operated on at St. Margaret's Emergency Hospital, Epping, and I wish to express my thanks to Dr. Bullough, the Medical Officer of Health for Essex, for his permission to publish them.

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A VARIX OF THE SPINAL CORD

CASE REPORT WITH A DIAGNOSTIC RADIOLOGICAL APPEARANCE AND DESCRIPTION OF TUMOUR

By G. A. RANSOME and E. C. MEKIE

SINGAPORE, STRAITS SETTLEMENTS

A study of the incidence of blood-vessel tumours of the spinal cord reveals some interesting facts. Rasmussen, Kernohan, and Adson[6] analysed the material at the Mayo Clinic, where 557 verified spinal-cord tumours were available for study. Of these, 18 per cent were in the cervical region and 19 per cent of these cervical tumours were vascular. The location of these tumours with respect to the dura was not given. In a later study from the Mayo Clinic by Craig and Shelden,[3] only tumours of the cervical portion of the spinal cord were reviewed. Of 597 verified tumours of the spinal cord, 91 were in the cervical region and of these 44 were intradural and extramedullary. Among these 44 cases there were 1 angiomatous varix, 4 hemangiomas, and 2 hemangioma-endotheliomas. Frazier and Allen[4] gave an incidence of verified vascular tumours of 1 per cent. This suggests the rarity of the type of the tumour found in the case presented below.

Bucy[2] says, "The racemose type composed of numerous large tortuous thin-walled vessels, involving the spinal cord or its membranes or both is the most frequent of these blood-vessel tumours". This agrees with the study presented by Globus and Doshay.[5] They divided the cases which they found in the literature as follows: (1) Venous dilatations, 28 cases; (2) Arterial or arteriovenous aneurysms, 7 cases; (3) Hemangiomas, 21 cases, of which only 3 were extramedullary and intradural.

These lesions are difficult to diagnose. Craig and Shelden[3] say, "Vascular tumours, either hemangiomas or hemangio-endotheliomas, seldom present any clinical features which are sufficiently characteristic to warrant a pre-operative diagnosis". Black and Faber[1] report a blood-vessel tumour found by them. They also note that the diagnosis is difficult and that angiomata of the skin were found in only 2 of the reported cases. They found that iodized oil showed a droplet formation at the level of the obstruction and reproduced an X-ray photograph in confirmation. In their case the Froin syndrome was found and the Queckenstedt test changed from negative to positive below the lesion after the withdrawal of fluid. They believe that this affords a characteristic and probably pathognomonic picture of subarachnoid varices and vascular tumours large enough to cause obstruction.

In the case presented below, a curious X-ray appearance which is similar to that of Black and Faber's was found.

CASE REPORT

Case History.—The patient was an intelligent English-speaking Chinese clerk, aged 32, who was admitted to the hospital on March 18, 1941, under the care of one of us (G. A. R.). Eight years before he had had a sudden severe pain in the small of the back. The pain was shooting in character, but did not radiate to the legs. It lasted for two weeks and gradually disappeared. It was not severe enough to make him take to his bed and he regarded it as a simple lumbago. He remained perfectly well until four years ago, when, for the first time, a weakness of the legs was noticed. This was of extremely gradual and undramatic onset. He observed that he seemed worse in the morning soon after getting up, but towards the end of the day he was better. The right leg at first gave the most trouble. This continued for two years, sometimes a little worse, sometimes a little better, but with a gradual deterioration. Two years ago micturition became affected and he complained of urgency at one time and hesitancy at another. Rectal control was in no way affected. A year ago he noticed a feeling of numbness around the waist and of the skin of the lower half of the right hand. About this time, too, he became impotent. There was desire, but a failure of erection. Mechanical stimulation would produce an erection, but it was not lasting. For the last three or four months before admission, the gait had become noticeably more spastic, but the patient was able to walk to his office daily. Direct questioning failed to reveal that he had had any pain which suggested a root origin at any time during these four years.

Clinical Examination.—When examined on the day of admission, the patient had a healthy and alert appearance and was able to give an excellent history. He walked with a very pronounced spastic gait. It was noticeable that he held the fingers of his right hand in flexion, particularly the ring finger, and rather less the little finger. There was no evidence of any cutaneous angiomata or of visceral disease.

Neurological Examination.—No abnormality was found in the cranial nerves.

Motor System: There was slight wasting of the small muscles of both hands, but this was not striking. No 'group' wasting of the muscles of the upper limb, the shoulder girdle, or the paravertebral region was found. Flexion of the elbow was powerful on both sides. Extension on the right was markedly weak; on the left, good. Adduction of both arms was weak, but was considerably more powerful on the left than on the right. Abduction was powerful on both sides.

The grasp on the right side was approximately one-fifth normal, and on the left a little stronger. Individual movements, carried out by the muscles innervated by the median and ulnar nerve-roots, were possible but weak. Tone was increased in the extensor group of both arms and more marked on the right. Flexor tone of the arms was normal, of the forearms increased, and finger clonus was present.

The intercostal muscles contracted feebly during respiration and while coughing. On screening, the diaphragm was seen to contract well and the thrust was good. The muscles of the dorsal spine and abdomen were weak. The abdominal muscles could be contracted at will, but the contraction was very poorly maintained. The patient adopted the tripod position when sitting.

The lower extremities were weak. Flexion of the right knee was very weak and on the left a little stronger. This was also true for abduction, adduction of the thigh, and dorsiflexion of the foot. Plantar flexion was powerful on both sides. The tone in the lower extremities was markedly increased. Spontaneous dorsiflexor movements of the toes were present. Patellar clonus was present on the right side, but not on the left, and ankle clonus was not obtained.

Reflexes: The reflexes are shown on the chart below, the intensity of response being marked by +.

	Right	*Left*
Biceps	+++	+
Triceps	+++	+++
Supinator	+	+
Finger jerk	+++	+
Pronator jerk	o	+
Finger clonus	present	
Abdominal jerks	absent	
Bulbocavernosus	present	
Cremaster	o	o
Knee-jerk	++++	++++
Ankle-jerk	++	+
Patella-jerk	++++	++
Plantar	extensor	extensor
Rossolimo	+	+

Sensation (*Fig.* 278): There was hypo-algesia to pin-prick over both arms. This included the ulnar half of each arm and forearm, the medial three fingers of the right hand and the medial two of the left. This hypo-algesia extended to the axillary folds. There was hypo-algesia from above the nipple of the right side and below the nipple on the left to the level of the umbilicus. This hypo-algesia was less intense than that of the arm strips. There was definite anæsthesia from the umbilicus, extending down to the front of the thighs and corresponding roughly to an area from the sixth cervical to the second lumbar dermatome. The saddle area and the legs were also hypo-algesic. Light touch tested with cotton-wool showed a definite hypo-æsthesia corresponding to pin-prick, but was nowhere absent. Sensibility for heat and cold corresponded roughly with pin-prick, but seemed rather more affected in the legs. Vibration sense was not diminished when tested with a C 128 fork over every finger, over the spine, and over the malleoli. Position sense was very good in the fingers and over the proximal joints of the upper and lower extremities. Big-toe position sense was impaired considerably on the right side, though the patient had an idea of toe movement and was more often right than wrong; on the left side about one mistake in six or seven movements would be made. Two-point compass sense and stereognosis were intact over both upper extremities. Testicular sensation and deep pain were present.

Manometric Examination: Lumbar puncture—the initial pressure was 120 mm. with a rise to 200 mm. in five seconds on jugular compression; fourteen seconds after release, it fell to a new level of 150 mm. of water.

The cerebrospinal fluid was clear and colourless. It contained one cell per cubic mm. and 70 mg. per cent of protein. The Pandy test was negative. The Wassermann reaction was negative in blood and cerebrospinal fluid. Cisternal puncture showed protein of 20 mg. per cent and a cell count of 3.

Radiological Examination.—A radiograph of the cervical spine was taken. This showed no increased bore of the canal at the level of the suspected lesion and no shadows suggestive of vertebral hæmangioma.

Lipiodol was injected in the prone position with the head slightly tilted, 2 c.c. being introduced by cisternal puncture. The X-ray picture revealed a partial block at the lower border of the fifth cervical vertebra. On screening a peculiar appearance was seen. The lipiodol was running down in five or six tortuous little runnels, not unlike barium running through a malignant growth of the œsophagus. At the lower end of the obstruction, which seemed about 1½ in. long, the lipiodol dripped in large drops to the bottom of the funiculus. Dr. B. J. Ess, the radiologist, was able to secure a picture of these runnels which is reproduced here (*Fig.* 279, A, B). Root pains developed after the injection of lipiodol.

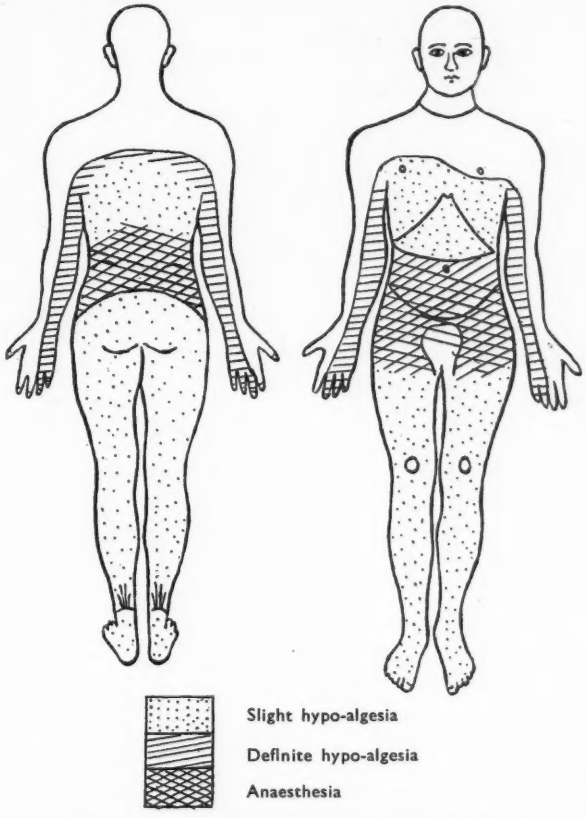


FIG. 278.—Sensory chart, showing areas of hypo-algesia and anæsthesia.

PRE-OPERATIVE DIAGNOSIS.—The diagnosis of a spinal compression of unknown character at C.5–6 was made. There seemed to be an intrathecal, possibly

intramedullary, lesion compressing the right and left pyramidal tracts, but more marked on the right than on the left. It was curious how the lumbar element of the pyramidal tract seemed more involved than the sacral. The spinothalamic tract was also interfered with on both sides. Wasting was not marked in any one group of muscles such as would have been expected in syrinx.

In concluding the discussion of this case on the clinical side there arises a point of great interest. Having seen previous cases of cord tumour recover save for a little residual spasticity, we felt pre-operatively, that if this patient had a removable tumour, there would be a considerable amount of recovery. In similar cases one often has wondered how much actual damage had been done to the pyramidal tract from the point of irretrievable degeneration.

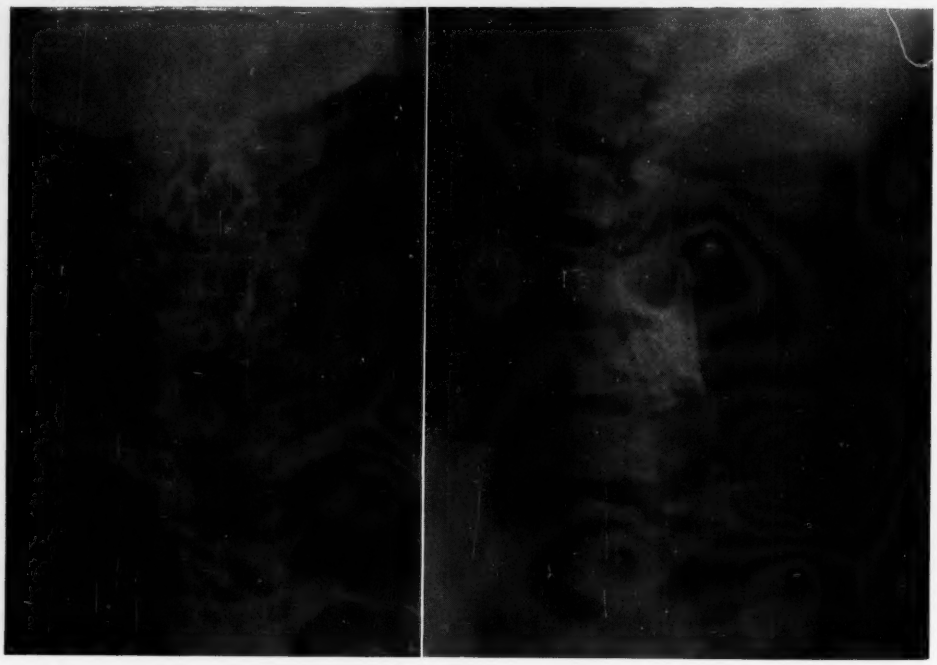
An exploratory laminectomy was advised and carried out on March 26, 1941.

Operation Notes (E. C. M.).—Intratracheal ether with basal avertin was used as an anæsthetic. The patient was placed in the prone position with the neck flexed. The incision employed was approximately 5 in. long, curved to the left and centred on C.5–6. The skin-flap was elevated and the ligamentum nuchæ was defined. The lower attachment of the ligament was then freed by division of the spinous processes of C.7 and T.1. The other spinous processes were then cleared and those of C.4, 5, and 6 were removed. The posterior laminæ were cleared and removed, the underlying dura being exposed.

The patient's general condition was reviewed at this stage, and while there had been a slight increase in the pulse-rate, the blood-pressure and respiration rate had not altered.

As soon as the dura was opened and the underlying tumour exposed, there was a considerable degree of impairment of respiration with jerky and irregular breathing. The pulse-rate rose and the blood-pressure fell. As no evident interference with the tumour was practicable, the wound was rapidly closed. The general condition did not improve and the patient died half an hour after the completion of the operation.

Description of Tumour.—When the posterior aspect of the cord was exposed at operation, the dura was observed to be expanded both laterally and posteriorly, with a consequent displacement of the extradural fat. Through the dura a bluish mass was apparent. When the meninges were opened, the tumour presented; it consisted of a mass of convoluted non-pulsating venous channels. The vertical length of the tumour was approximately 2 cm. and from side to side measured 1·5 cm. The upper limit of the tumour mass was at the level of the point of emergence of the posterior roots of the fourth cervical nerve, while the lower limit was at the level of the seventh cervical segment. The tumour lay more towards the right than to the left side, so that while the left lateral margin of the cord was visible, the tumour appeared to be encircling the right margin.



A B

Fig. 279.—Radiographs taken after lipiodol injections. A, Postero-anterior view; B, Lateral view.

Descending from above, in the middle line of the cord, was a large vein (posterior spinal vein); at the upper margin of the tumour, this vein deviated to the left, passed along the margin of the tumour, and then turned sharply upward superficial to the tumour, where it became lost as an entity in the tumour mass.

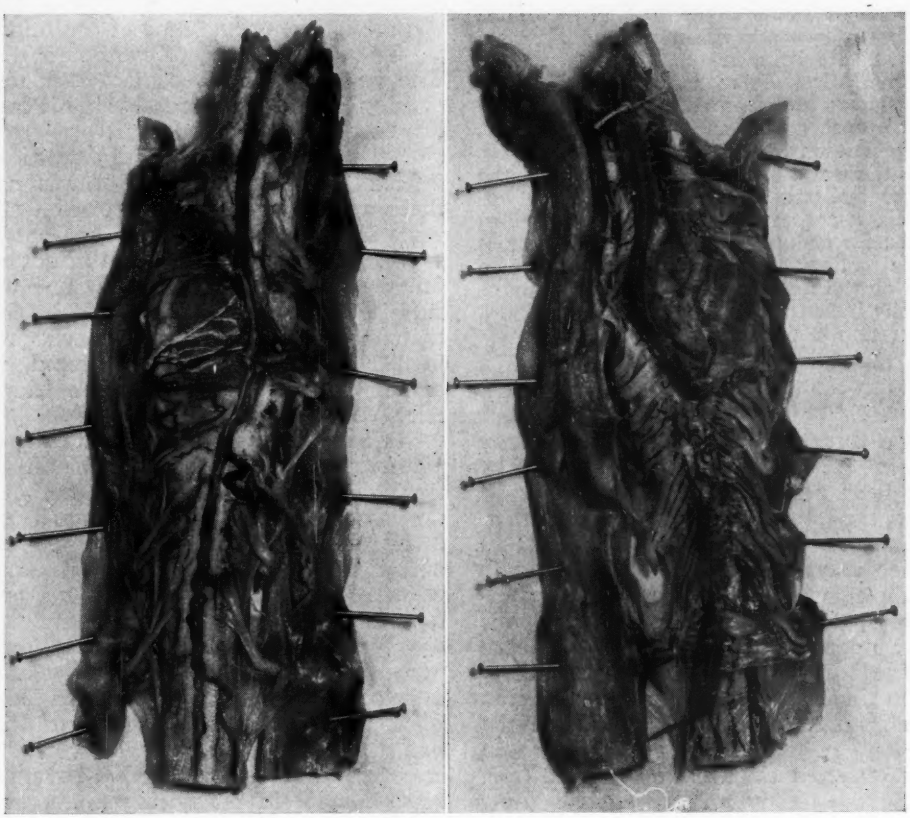
A second prominent venous connexion, which appeared to originate from the tumour, passed upwards, superficial to the tumour, and, forming a loop above the lower group of rootlets of the fourth cervical, then turned forwards at the right lateral border of the cord.

The tumour itself, which was roughly ovoid in shape, consisted of convoluted venous channels, but

the individuality of these was obscured by the way in which they intermingled and by the manner in which they were bound together by loose connective tissue.

The anterior aspect of the tumour was not observed during life, but when the dura of the post-mortem specimen was opened, the tumour mass presenting anteriorly was smaller in size than that seen posteriorly. Above, the anterior root of the fourth cervical segment seemed to be arching slightly over the upper pole of the tumour while the lower pole was at the level of the point of emergence of the sixth cervical fibres.

At the level of the sixth cervical segment, two large veins communicated with the anterior spinal vein. The vein on the right side kept close to the lower border of the tumour mass and was lost to view as it passed through the dura with the sixth cervical nerve. The second vein passed toward the left, pursued a more tortuous course and ultimately became associated with the seventh root. On the left side, at the level of the fifth nerve, a leash of vessels was observed. Some of these appeared to end in relation to the anterior spinal vessels, while others, passing deep to the anterior spinal vessels,



A B

FIG. 280.—Varix of spinal cord. A, Anterior view; B, Posterior view.

The anterior spinal vessels were deviated towards the left by the tumour and formed its left boundary. To the left side (laterally) of the tumour mass, a strap-like segment of the spinal cord was visible, suggesting from this appearance that the tumour had grown backwards through the substance of the cord, causing a longitudinal split, and the strap-like segment was composed, therefore, of those fibres which had been separated to the lateral side. Coursing over the tumour were the anterior rootlets of the fifth cervical nerve.

The anterior spinal vessels were unduly enlarged. Joining the anterior spinal vein at the level of the fourth cervical root was a comparatively large venous channel which appeared from amongst the rootlets of the fourth cervical root, and which was the termination of the second venous channel to which attention has already been drawn in the description of the posterior aspect.

communicated with the tumour. Laterally these veins passed through the dura with the fifth root.

On the anterior aspect, as posteriorly, the tumour presented the appearance of a mass of closely related convoluted venous channels. Photographs of the tumour, showing these characteristics, are reproduced (*Fig.* 280, A, B).

Following the removal of the cord, gelatin coloured with methylene blue was injected to prevent the collapse of the venous channels. The injection was made through the venous channel above the fourth cervical rootlets at the right lateral border of the cord. The gelatin was seen to fill the tumour mass completely and emerged from the upper end of the posterior spinal vein, which in consequence, required a ligature. This was presumptive evidence that the tumour was, in fact, a simple varicosity.

The histological study was made by Dr. H. O. Hopkins, Government Pathologist, Straits

Settlements. A section was taken through the tumour itself. It showed pia mater covering a collection of spaces of varying size containing red and white blood-cells. The walls of these blood spaces were well defined and consisted of fibrous tissue lined by a single layer of endothelial cells. Organizing thrombus was present in one of the spaces. Most of the spaces showed evidence of the mixture of gelatin and methylene blue previously injected.

The histological picture suggests that these blood spaces were in fact tortuous and dilated veins, and that the condition was that of varix of the spinal pia mater.

A study was also made of sections of the spinal cord taken from above and below the tumour. No degeneration of the cells in the grey matter was observed. The Weigert-Pal sections below the tumour showed some degeneration on the right side in the lateral corticospinal tract and sulcomarginal tract, with less degeneration in the rubrospinal tract. On the left side there was a slight degeneration in the lateral corticospinal tract.

In the Weigert-Pal section taken above the tumour, the cord had been compressed and was slightly misshapen. The column of Burdach showed some degeneration on the right side leaving the column of Goll practically intact. On the left side there was a slight degeneration in the column of Burdach.

DISCUSSION

There are three clinical features which may be helpful in the diagnosis of this condition. These have been recognized since the paper by Sargent[7] in 1925, and probably before that. They are: (1) A previous history of a spinal episode which may range from a 'lumbago' to a painful 'diplegia', usually with some or complete recovery; (2) A fluctuation of symptoms daily or over a period of time; (3) The presence of angiomata elsewhere on the body, particularly if they are in the same segment as the suspected lesion. Globus and Doshay also analysed the symptomatology of these tumours as shown in their own cases[4] and cases from literature (24). However, from a study of these, one must concur with the conclusion of Craig and Shelden that pre-operative diagnosis is extremely difficult.

In our case the only pain was a lumbago eight years before. Its onset was sudden, but not eclamptic, and it lasted for about two weeks. There was no radiation, and though one might suspect, in retrospect, that this was in reality root pains from a small blood-leak, one cannot be certain.

The four years that passed between the onset of leg symptoms and the patient's final demise were conspicuous by their absence of pain. An extramedullary tumour in this region of the cord would probably have produced some form of root pain, though one has seen cases which do not, even with the same amount of paresis that this man had.

After lumbar puncture there were no root pains. It has been our experience and of others,[3] that, after a lumbar puncture, pains commonly appear, levels become clearer, and pyramidal signs more marked. Lipiodol, in this case, as it almost invariably does, produced segmental pains at the site of the lesion. This absence of focal pain in the presence of such a severe lesion is of interest, though not diagnostic.

The dissociation of anæsthesia in this case was marked. The hands might almost pass for those of a syringomyelic, though there were no trophic changes. It has been pointed out by Craig and Shelden that dissociated anæsthesia is a constant accompaniment of all types of lesions of the cervical cord but in itself is not diagnostic of any one type of condition.

Certain fluctuation of symptoms was noticed. The patient would become better towards the evening. This was noticeable in his early history, but became less marked later.

The manometric readings were of special interest. The initial pressure was normal and there was a rapid rise on occlusion of the deep veins in the neck. If timing had not been done as to speed of rise and fall and height of pressure following compression, possibly one would have surmised that there was no block. In view of the amount of radiological block present, the jugular rise of pressure was rapid, too rapid, perhaps, if the tumour had been less compressible.

Injection of lipiodol before taking the X-ray picture seems to give the most helpful diagnostic sign. The radiological appearance in our case was most striking. While it was not correctly interpreted until the tumour was exposed at operation, the appearance was so unusual that we were convinced that it was not an ordinary tumour such as a meningioma.

Following the operation, the literature was reviewed and it was discovered that a similar radiological appearance had been observed by Black and Faber. They were of the opinion that this droplet or runnel formation was an important diagnostic sign. We have, in the past, used lipiodol in diagnosing a number of cord tumours, but have never before observed this peculiar and, we believe, characteristic effect. It, therefore, seems important to call attention to this radiological picture since it does not appear to have gained the attention it deserves. Such a sign, added to the better-known ones, should be regarded as very strong diagnostic evidence in favour of subpial varicosities and make a pre-operative diagnosis possible in a large proportion of the cases.

The study of the section of the tumour itself showed without any doubt that this was a simple varicosity, causing the pressure symptoms noted in the clinical study. The degeneration of the cord was nowhere marked. Such degeneration as had taken place was of a patchy character and was probably due to the intermittent pressure exerted by the varicose veins. As was stated earlier, much return of function should have been expected had the varicosity been removable.

SUMMARY

A case of cord compression caused by venous dilatations is presented. The X-ray picture taken after the injection of lipiodol was particularly informative and should lead to more exact pre-operative diagnosis in the future.

This case is reported with kind permission of the Director of Medical Services, Straits Settlements.

We wish to acknowledge our indebtedness to Helen Burn, M.Sc., research student in neuropathology of the College of Medicine, for valuable assistance in the preparation of this paper.

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SPONTANEOUS DISAPPEARANCE OF PHOSPHATIC DEPOSITS FROM THE URINARY TRACT

By R. MILNES WALKER

SURGEON, E.M.S., AND ROYAL HOSPITAL, WOLVERHAMPTON

AND J. W. THOMPSON

RESIDENT MEDICAL OFFICER AT AN E.M.S. HOSPITAL

THE following case is recorded on account of the extraordinarily rapid appearance and disappearance of shadows in the urinary tract which were produced by accumulations of phosphates, associated with the apparent return to normal size of a hydronephrotic kidney. The pelvis and calices of the right kidney and also the right ureter during a period of two months became crammed full of these crystals, so that an X-ray plate had the appearance of a pyelogram, and on the left side a further accumulation of crystals occupied the pelvis and calices of the kidney. A quantity of these crystals was removed from the right ureter, but most of the remaining masses disappeared spontaneously, and were evidently either dissolved or passed in the urine, though lavage of the left kidney probably assisted the process.

CASE REPORT

The patient, a soldier, aged 21, was severely wounded by shell fragments in France on April 28, 1940. He sustained a compound fracture of the right iliac bone; at the Casualty Clearing Station a piece of metal $2\frac{1}{2} \times 1 \times \frac{1}{2}$ in. was extracted from the front of the sacrum, together with fragments of the iliac bone, but his poor condition prevented the surgical toilet from being completed; fourteen days later, as it was necessary to evacuate the clearing station, the hip was put in a plaster spica, though he was running a high temperature and a blood-count showed R.B.C. 2,400,000, Hb 65 per cent, and W.B.C. 11,000. After being evacuated from one hospital to another during those hectic days, he finally reached an E.M.S. Hospital in this country twenty-five days after his injury, having spent four days on the final stage of his journey from his last hospital in France.

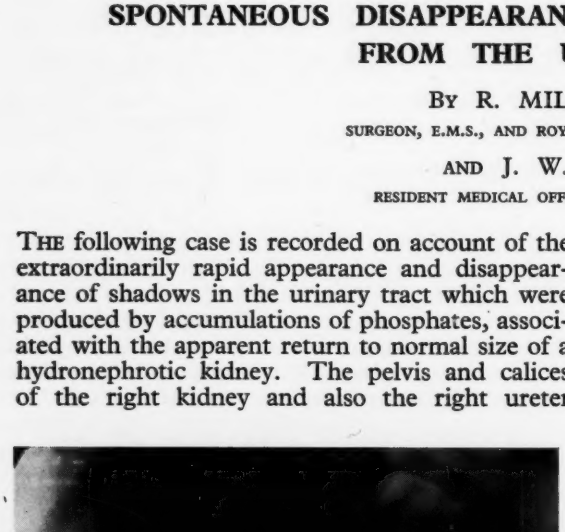

FIG. 281.—Straight radiogr ph, March 21, 1941. Accumulations of phosphates occupying the right kidney and ureter, and in the left kidney. Note the injury to the right iliac bone.

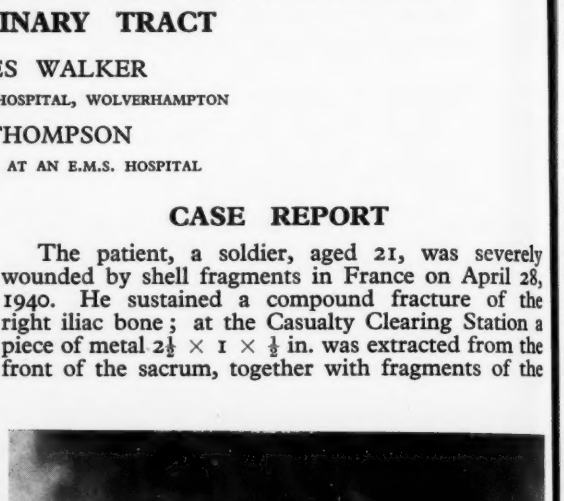

FIG. 282.—Intravenous pyelogram, March 22, 1941. Bilateral hydronephrosis

The wound was treated in a closed plaster, which was changed about every six weeks, sequestra being removed at each dressing. From July onwards, sulphanilamide was sprayed into the wound at each dressing, before vaseline gauze was applied. The plaster was finally discarded on Nov. 27, and the wound had completely epithelialized by April, 1941.

The first indication of any abnormality in the urinary tract was an attack of hæmaturia on July 31, 1940, which lasted only a few hours. The urine at that time showed no excess of leucocytes, though many red blood-cells were present, together with Gram-positive cocci. Further attacks of hæmaturia occurred at occasional intervals, but as the patient was still suffering from toxæmia as a result of his infected wound, the hæmaturia was considered to be a toxic manifestation, though its possible connexion with the administration of sulphanilamide was borne in mind. Radiographs of the pelvis up to Jan. 1, 1941, showed no shadows in the right ureter. As soon as his condition permitted, thorough investigation of the urinary tract was undertaken.

On March 21, 1941, a straight radiograph (*Fig.* 281) showed rounded indefinite shadows in the right renal area, two shadows each ½ in. in diameter opposite the transverse processes of the third and fourth lumbar vertebræ, and a continuous shadow, varying in width from ¼ in. to ½ in., extending from the lower border of the transverse process of the fourth lumbar vertebra to a point 1 in. above the ischial spine. On the left side were two indefinite rounded shadows, each 1½ in. in diameter in the renal area. An intravenous pyelogram at this time (*Fig.* 282) showed a marked bilateral hydronephrosis. The blood-urea was 46 mg. per cent.

On March 26, 1941, a cystoscopy was carried out; the bladder interior appeared normal; a catheter could be passed 5 cm. up the right ureter, at which point its passage was obstructed; up the left ureter a catheter was passed without difficulty to the kidney; the renal pelvis was irrigated through this catheter with normal saline, in the hope of washing some of the deposits down the ureter. The urine at that time was sterile, contained a trace of albumin, many blood-cells, but no excess of leucocytes. The urine also contained sulphanilamide (free plus acetyl sulphanilamide) 40·25 mg. per cent, which is within normal limits for patients receiving this drug. From this time onwards he was given acid sodium phosphate in sufficient doses to maintain his urine acid to litmus. A radiograph four weeks later (*Fig.* 283) showed only a single small shadow in the left renal area, but the shadows in the line of the right ureter had increased and were now continuous with one another.

On May 7, 1941, exploration of the right ureter was undertaken. Owing to his wound, an extraperitoneal approach was impossible, so a right paramedian incision was employed, and the peritoneal cavity opened. The left kidney was felt to be a little enlarged, but no stones were felt; the right kidney was enlarged and the pelvis filled with a hard mass. The ureter was distended to ½ in. diameter by gravel, so hard that it could not be impressed with the fingers, as far as a point 1 in. below the brim of the pelvis, where is became involved in scar tissue in the region of his bony injury. The ureter was opened by an incision 1 in. long, and masses of crystalline deposits removed with the aid of a spoon, and by 'milking' the ureter, which was only possible after some of the mass had been extracted. The opening in the ureter was about 1 in. above the pelvic brim, and no crystals were extracted from the kidney itself. Following this, a bougie could be passed up into the kidney pelvis, but all attempts to pass it downwards to the bladder failed to get past the stricture at the site of his bony injury. The wall of the ureter was sutured and the wound drained extraperitoneally. Apart from some post-operative abdominal distension, he made a rapid recovery, the operation wound healing without urinary drainage. The crystals removed weighed 5·9 g., and were shown to consist entirely of phosphates; no sulphanilamide or acetyl sulphanilamide was detected.

FIG. 283.—Straight radiograph, April 26, 1941. Four weeks after lavage of the left kidney. There is an increase in the shadows in the right kidney and ureter, but those on the left side have almost disappeared.

By July 2, 1941, his blood-urea was 29 mg. per cent; a radiograph (*Fig.* 284) showed only two small shadows in the right ureter, opposite the third lumbar vertebra, and none in the right kidney; small shadows were present in three calices of the left kidney. A pyelogram (*Fig.* 285) showed that the left kidney excreted well and that the hydronephrosis on this side had returned almost to normal; only slight excretion was seen from the right kidney.

He returned to his home on July 14, 1941.

Radiographs taken on Dec. 18, 1941, show no shadows in the region of the right kidney or ureter, but a single small shadow 0·9 cm. in its longest diameter on the left side in the region of the lowest calix of the kidney.

DISCUSSION

The main point of interest in this case is the disappearance of the shadows; though they probably represented masses of loosely matted crystals, rather than solid stones, those in the ureter when it was opened at operation were

very compact and considerable difficulty was experienced in removing them. There are very few records in the literature of spontaneous disappearance of shadows of renal calculi, and most of the monographs on urinary lithiasis do not even mention the possibility of such an occurrence. Higgins has reported a series of cases, in which treatment by acid-ash, high vitamin diet was administered, and a number of successes were recorded, though other workers do not appear to have had the same degree of success with his methods. Even he admits no success with large bilateral shadows. This case is in agreement with the usual findings where investigation has been carried out, that in orthopædic cases where calculi appear in the urinary tract during long periods of recumbency they consist entirely of phosphates. It is surmised that the poor function of the right kidney, as shown by the last intravenous pyelogram, is attributable to the effect on the kidney of the organic stricture of the ureter, which was the result of his wound. Urine must have been excreted in order to account for the disappearance of the shadows in this kidney, though it is curious that there was no drainage of urine from his wound; great care had been taken in suturing the wall of the ureter, in order to avoid any leakage into the peritoneal cavity, and owing to the ureteral dilatation it was possible to insert a double row of sutures. It is hoped that opportunity will arise at a later date to make a check-up on the function of this man's urinary tract.

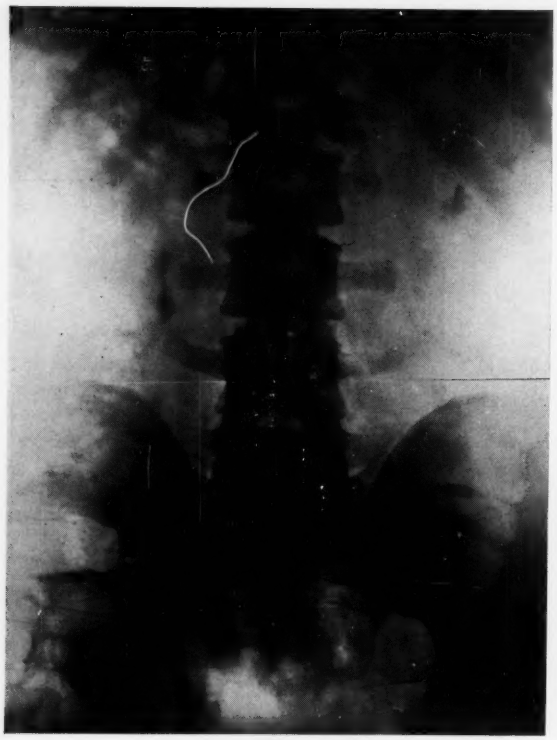

FIG. 284.—Straight radiograph, July 2, 1941. Eight weeks after exploration of the right ureter. Shadows have disappeared from the right kidney, and only two small ones are present in the ureter. There has been a little increase in the shadows in the left kidney.

FIG. 285.—Intravenous pyelogram, July 4, 1941. The pelvis and calices of the left kidney have resumed their normal shape, and this kidney excretes well. Only slight excretion is seen on the right side.

The first lesson to be learnt is that in these orthopædic cases steps should be taken to maintain an acid urine, and even if stones have formed it is worth while attempting medical treatment before their surgical removal is contemplated; it is unfortunate that no records of the *p*H of the urine were kept in this case, but treatment on the lines suggested by Higgins is advised. The second lesson is that when a hydronephrosis is the result of phosphatic deposits, a kidney with quite a severe degree of hydronephrosis can return to normal without surgical intervention.

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THE EXAMINATION OF NIGHT VISUAL CAPACITY IN RELATION TO FLYING

By Group Captain P. C. LIVINGSTON

The hours from dusk to dawn have taken on a new significance. The value of keen eyesight under conditions of threshold illumination, a subject always of interest, has now assumed great practical importance.

In this paper an attempt is made to explore new regions associated with the capacity to see at night. In so doing it has been necessary to ward off any tendency to accept standard procedures and the employment of equipment previously designed for other studies into the character of night vision.

RECENT WORK ON DARK ADAPTATION

In recent years attention has been focused upon the relationship that is considered to exist between deficiency of certain vitamins in the diet and night visual disturbances (Hecht and Mandlebaum, 1939; Stewart, 1939; Tansley, 1939; Wald and Steven, 1939). Work has also been done upon the nature of dark adaptation as a general conception (Craik and Vernon, 1941), and upon the importance of the light sense as a test for fitness for flying (Ferree and Rand, 1937). To Lythgoe we owe a fine review of this literature (1940), while a most extensive bibliography is that compiled under the title "Documenta Ophthalmologica" (1938).

This attack upon the mechanism of sight, as it concerns function under the handicap of darkness, is heralded by the development of various types of instrument, considered by each investigator to be the most suitable for the special reactions isolated for examination. The fact that design, which is the visible reflection of trend of thought, is marked by radical differences, helps to confirm the extreme complexity of the subject.

Where the influence of diet is under consideration, it is necessary to guard against the introduction of any but the most simple stimulus. For this purpose, therefore, the apparatus designed by Steven appears best to meet requirements, because judgement is based upon a single carefully controlled flash of light, so graduated as to cover all states of dark adaptation. The biophotometric method still maintains a leading role in the detection of vitamin A deficiency, which is recognized as closely associated with hemeralopia. It is well known (Sir Edward Mellanby, 1934) that where a deficiency of vitamin A is pronounced, the clinical picture becomes clear and characteristic. It has been found, however, that the employment of vitamin A, concentrated even in large doses, and over long periods, does not benefit a subject possessing a purely physiological weakness in night visual capacity. If a search is being made for the earliest signs of true vitamin insufficiency in diet, the test evolved to elucidate this must be of an extremely delicate, and, at the same time, elementary, nature.

From this basic conception, design spreads to meet conditions which involve higher analysis; from the matching of a given background by one which is under the control of the observer (Craik), to the description of the nature of an object and its relative position, such as an arrow (Haines, 1938) or a letter (Mutch et al., 1937).

Nor does the matter end here, because controversy arises regarding the treatment to which the retina should be subjected before standard and comparable measurements can be taken, and whether there is more to be gained by employing one or both eyes during the test. Regarding the first point, is it correct, for instance, to produce an equal retinal level in all observers by using strong light for the purpose of glaring the eyes and bleaching the visual purple, or is it better to allow more natural phenomena to occur, by introducing a carefully regulated period in which the subjects are kept in a state of darkness? Much study has been given to the influence of pre-examination conditions upon the eventual adaptation curves. Some believe that, in order to produce a common level, nothing short of bleaching by means of strong light in excess of any previous natural exposure will suffice. Exposures of this character may be in the nature of 2000 ft.-candles directed into the eyes from a distance of 1 ft. over a wide field. As a precaution, calorex glass spectacles are employed. These serve the double purpose of reducing ultra-violet and infra-red effects. To this, as with so much that concerns studies associated with visual pathway, there is an opposite argument. Strong glare reacts upon different subjects differently, according to their state of tolerance to excessive light. Those who are glare sensitive may experience extreme discomfort, amounting even to pain. They may suffer from suffusion of the conjunctiva and acute epiphora. Nor has it been fully proved that the after-images essential to such a procedure remove themselves from the field of vision in an equal and orderly fashion, so as not to interfere in any manner with the curve of dark adaptation in its

pure form. Here it becomes necessary to discriminate between the scientist as a subject for such tests, and the uninitiated.

For the examination of Air Force personnel it is clear that a binocular test should provide the basis for examination, and it is maintained in this paper that, so different can be the characteristics of two eyes, it is not possible without examining very great numbers to produce evidence to substantiate the claim made for monocular tests. As 85 per cent of subjects possess a right master eye, there remain 15 per cent who would, for comparative purposes, require to be examined by a left-eye test. Hence, to be accurate, a further test for master eye would have to be undertaken. It is felt strongly that the system of binocular examination must in the majority of cases raise response to a higher level, particularly in form sense reactions. Argument, however, still thrives upon the real value of summation of stimulus in this connexion, but present tendency inclines in favour of binocular reactions.

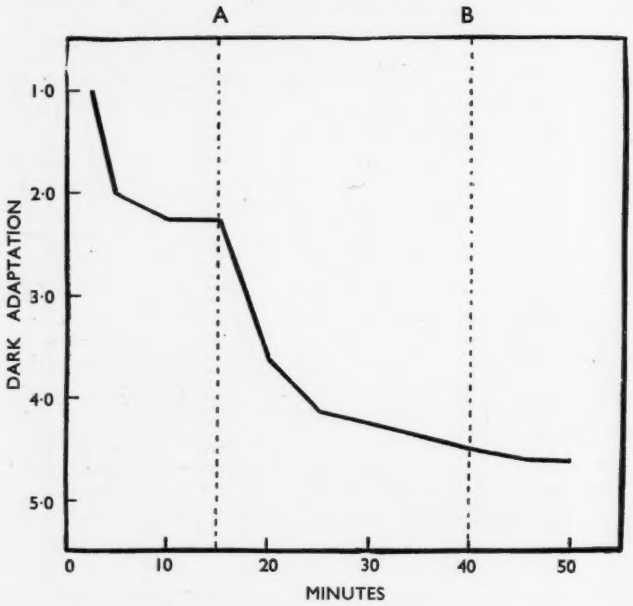

FIG. 286.—Chart demonstrating the influence of cone vision and rod vision upon dark adaptation. In respect of cone vision this is seen in the first part of the curve, and the optimum stage is reached in 10 minutes. Between A and B the effects of rod adaptation are demonstrated, the most active period lying between 15 and 40 minutes, after which time the curve rapidly flattens. (*After Craik.*)

TECHNIQUE DEVELOPED FOR THE ROYAL AIR FORCE

From a study of preceding work, it became clear that the approach to the problem of night flying should be sought from an angle which seemed most suited to meet practical requirements. The real problem was to endeavour to suit ophthalmic technique to visual reactions under flying conditions. In further justification for this attitude some experimental work carried out in 1936 is of interest. It was noted that in the interpretation of objects made indefinite by the close approach of object brightness to background brightness, the train of thought which results in the final answer may vary considerably between observers. There were two main groups in this connexion. In the first place, there was the subject who, upon receiving the least appreciable stimulus, began by guessing as to its nature, and continued so doing until he had reached the final answer. Eventually the pattern would assert itself sufficiently to become recognizable in its true form. The other group consisted of those subjects who, although aware of the presence of a stimulus, refused to commit themselves until they were certain as to its nature. The results obtained from these two opposite characteristics became classified in a private communication under the headings of " initial relative form appreciators " and " absolute form appreciators " respectively.

Nor could it have been possible to carry out the big programme of night visual examination by using a test applicable only to one subject at a time. For this reason an instrument was designed capable of examining six subjects simultaneously under exactly comparable conditions.

The next problem was to consider the character of stimulus to be presented, and the condition of illumination under which this was to be done. In order to acquire satisfactory data, it was evident that the maximum possible score should be capable of very wide separation from a score to be anticipated from a bad subject.

Finally, it seemed proper to create a standard condition of dark adaptation, not by a process of intense glare, which was quite foreign in daily experience, but to employ a passive technique, which fitted in with the routine life of flying personnel.

In brief, then, the requirements of the Royal Air Force in this association appeared to be best met by creating an apparatus which :—

a. Provided for a condition of preliminary preparation that caused no abnormal sensations, and acted as a passive introduction to the test itself.

b. Examined 6 personnel at a time, and could deal with 72 in the course of the day, by testing seven groups in the morning and five in the afternoon.

c. Produced a number of stimuli for solution, thus providing a wide scatter for the assessment of results.

Before proceeding to a description of the Royal Air Force night vision test and its technique, a brief reference should be made regarding the physiological processes of dark adaptation. When a subject is dark adapting two phases can be differentiated (*Fig.* 286). The first phase is associated with the reactions taking place in

central, photopic, or cone vision; a curve can be plotted which occupies approximately the first ten minutes. After this, central vision, having attained its highest value, resigns its effectiveness in favour of a curve of different character. This, the curve of paracentral, scotopic, or rod vision, goes on to attain its perfection in approximately sixty minutes from the commencement of the test.

panel. By rotating the whole instrument on its base it becomes possible to present all six panels to the same observer. As each panel contains 16 objects for analysis, there are therefore 96 possible combinations. The middle apertures contain three letters each, which may either be in the normal position or set in an abnormal way. The 'E' for instance, may be drawn looking up, down, or backwards. In the bottom aperture

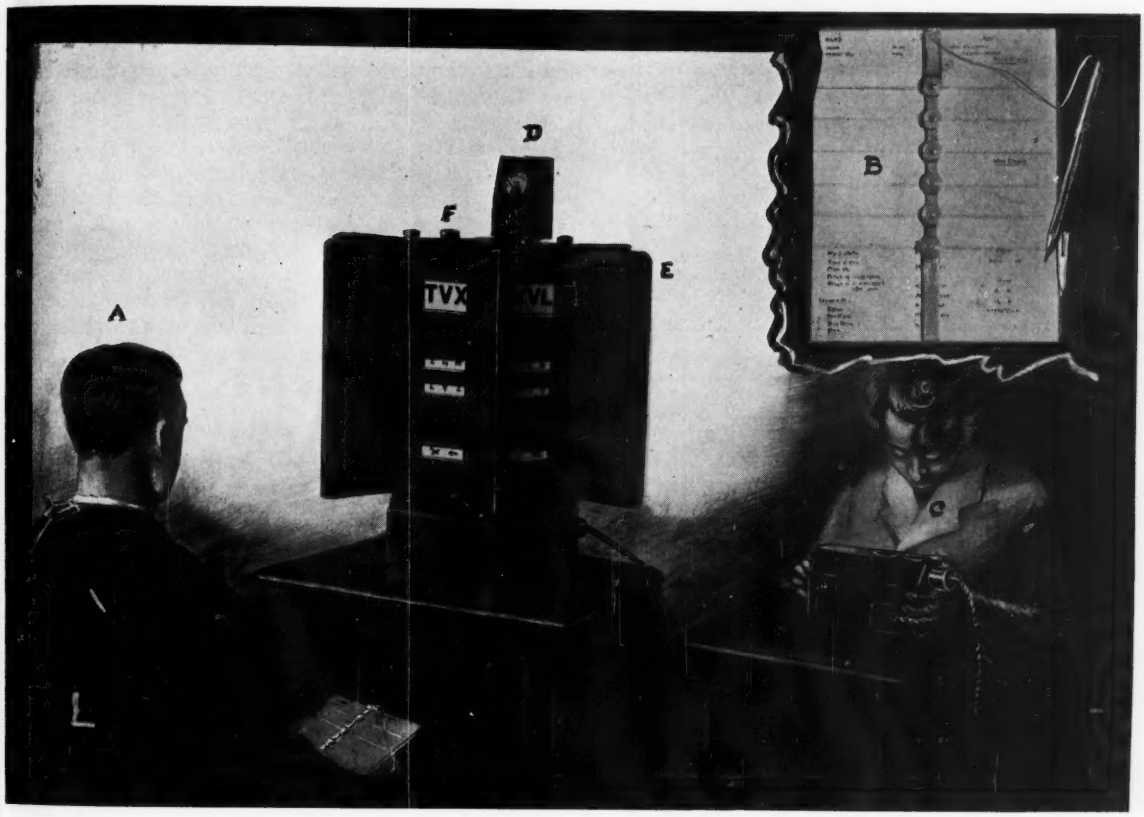

FIG. 287.—The rotating hexagon night vision apparatus. A, The observer holding his test board and Braille card (more clearly illustrated at B). C, The operator controlling the lighting of the apparatus by means of a graduated rheostatic connexion, worked by the right hand. This control box contains a stop-watch, a voltmeter, and switches by which the lighting can be changed from one panel to another. D, The micro-ammeter for testing the light value of the lamps in association with photo-electric cells. E, Partitions for separating each observer. F, Knobs by which the objects stencilled on the flashed opal screens can be changed. The whole instrument can be rotated on its base.

THE ROTATING HEXAGON

The instrument adapted to the requirements of the Royal Air Force consists of a six-sided metal structure 24 in. high, on a wooden base, with four rectangular apertures in each face (*Fig.* 287). The apertures associated with the standard test are those in the middle and bottom sections. In the middle section are two identical apertures separated by 1 in., while the bottom aperture is single. Behind each panel is a white flashed opal screen, visible only in the apertures. The screens can be moved up or down by means of knobs, so that the objects etched in black upon them can be readily altered. In this fashion it is possible to change the objects visible in each

are two objects such as an aircraft, an arrow, a cross. The top panel is only employed when consideration is being given to the examination of possible malingerers. The instrument is divided transversely by wooden partitions into three sections, corresponding to the apertures. Each is lighted by a central single electric 12-volt lamp of 4 watts, surrounded by a blue filter for the purpose of reducing the red effect of the lamps, which are burnt far below their normal capacity. Each lamp illuminates the six sides of its own section, so that every observer examined is subjected to the same brightness level.

The distance of each observer from his panel is one yard. The visual angle subtended by the

letters and objects at this distance, when taken separately, is not sufficiently large to stimulate the rod area, but when seen in groups as designed, the angle subtended is one of 6°, therefore meeting all requirements. Owing to this arrangement it can be shown that, under very low levels of illumination, the objects regarded separately by direct fixation tend to become indecipherable.

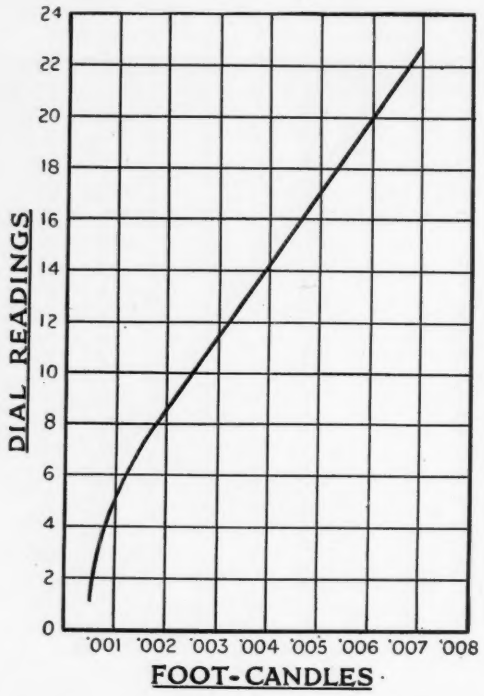

FIG. 288.—The luminosity curve of the apparatus. The principal readings are taken in a state of background brightness varying between 0·001 and 0·006 ft. candles, as the highest brightness corresponds to 20 on the dial control.

This, as stated above, is due to the inferior character of central vision at low-contrast levels. When, however, the eyes move from one object to another, the angle covered reaches well into the rod area of the retina, and so scotopic vision is stimulated; with the result that it becomes possible to record what is seen. The system of design based upon this principle has been created with a view to encourage observers to employ eccentric fixation in identifying aircraft at night, and the procedure employed in the test emphasizes the great value of this.

The arrangement for varying the illumination is incorporated in a box which holds, besides the rheostatic control, a stop watch and a voltmeter. The range of variation which is employed is shown in the luminosity curve (*Fig.* 288). In order to maintain accuracy in respect of the light given out by the three 4-watt lamps, a system of photo-electric cells is incorporated, and the light value of the lamps can be taken by a micro-ammeter. The whole system receives its supply through a freshly charged 12-volt accumulator, which is run for fifteen minutes before the tests commence.

Preparation of Personnel.—In order to be certain that the six subjects are in a comparable state of adaptation, dark goggles of equal transmission are worn for half an hour before entering the test room. They then enter this room, from which all light can be completely excluded. Certain points concerning the test are explained while the room is still illuminated. The light is then extinguished and the subjects, removing their dark goggles, remain in complete darkness for a further fifteen minutes. This total period of preparation, namely, forty-five minutes, is considered fully sufficient for accurate comparison.

Technique of the Test.—The principles of technique are briefly as follows:—

1. The six subjects are seated one yard from the instrument, and are so retained by means of special chair back supports.

2. The dark goggles are kept on while the test room remains lighted. Each subject is handed a card illustrating some of the characters which he will be expected to analyse, the light transmission of the goggles being sufficient for their scrutiny.

3. A board, on to which is clamped a Braille type card, is handed to each subject. The system of clamping by a central metal strip provided with buttons, easily differentiated in the dark, provides a means for localization. Pencils are attached.

4. The light in the dark room is then extinguished, and the adaptation goggles are removed, being handed through a trap door to an assistant who places them upon a further six subjects outside the dark room.

5. In the period of fifteen minutes in complete darkness, the full technique is carefully explained in the following terms:—

"You are each seated in front of a panel, which will be illuminated and will reveal certain objects and letters, similar in character to those which you have just seen. There are four tests, each corresponding to a metal button on your boards, and each is exactly similar in technique. You will find the buttons placed in such a way that you can feel three in series, followed by a gap, and then a fourth button. You will note that each button corresponds to a transverse grooved line upon the Braille card. As the buttons run down the middle of your boards, there is therefore a left and a right Braille line. Each test exposes first objects and next letters. On the LEFT space, you will write the names of OBJECTS recognized. If you cannot do this, endeavour to copy what you see. On the RIGHT space you will set down what you can detect of the letters. These should be so drawn that the upper group is above the grooved line, and the lower group just below it. The letters may be set in abnormal positions. Copy them as you see them. Each test is of one minute's exposure and test succeeds test without intermediate pause.

"On each occasion, the illumination will be slightly increased, till you reach the third test. Between this

test and the fourth you will be subjected to one minute of glare from an electric lamp suspended above the apparatus. During this time you must not look directly at the lamp, but slightly beneath it. After this you will be given your final test. The examination then is over."

While the fifteen-minute period is being passed, the operator gives a simple lecture upon elementary facts regarding night vision, upon the lowest group. It does not necessarily follow, however, that good night vision is essential for the efficient handling of aircraft at night. Many factors are involved, such as ability to interpret accurately the messages of the blind-flying instrument panel, confidence, and morale. This differentiation with regard to piloting is important, and it must always be emphasized that a test for night visual capacity must remain restricted to its

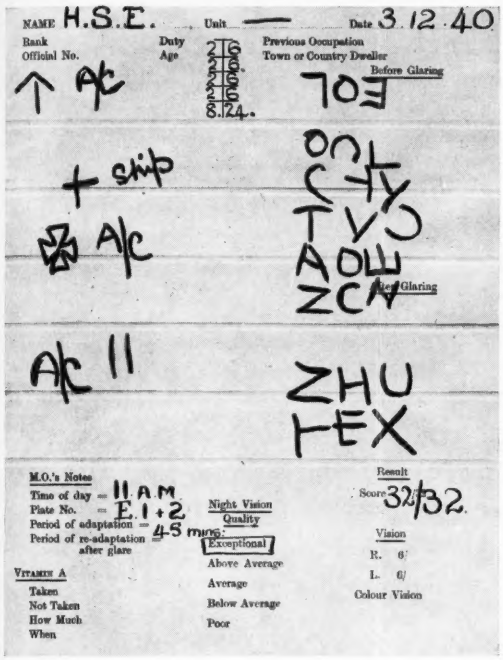

FIG. 289.—Card showing the highest score obtainable with the rotating hexagon, namely, 32/32, taken from a member of a night-fighter squadron. The writing in the dark is well formed and correctly placed, as well as being completely accurate for all luminosities.

FIG. 290.—Card illustrating a " poor " result. Irregular and inaccurate attempts have been made to carry out the test.

care of the eyes, or upon the influence of health and diet upon good sight.

Scoring (*Figs.* 289 and 290) is done by giving a mark for each correct answer, and from the results, subjects are graded according to their function as members of air crews. A differentiation is, for example, made between a night pilot of, say, bomber aircraft, and an air observer. It is important to retain a high degree of night vision in the case of observers. It is less important in the case of the pilot himself, because he is flying on lighted instruments and is fully engaged with his special duty.

At the extreme ends of the scale it has been found that approximately 3·5 per cent of personnel record between 30 and 32 marks, while 2·5 per cent score less than 2 marks. Between these come the main body of all subjects of the ages 18–30 years; the peak lying in the region of 20 marks.

Cases presented for examination who have histories of defective performance in night flying or night observing come almost invariably from basic purpose. On this account its application to the Air Gunner and Air Observer is of greater importance than to the Pilot, although, as the following history indicates, it can at times produce an explanation for failure in cases where other causative factors have been eliminated.

Pilot officer —, aged 23 years, single. Has flown 260 hours, of which 36 hours represented night flying. Visual acuity and visual judgement—normal. Complains of poor night vision, concerning which he has always been aware. Day flying satisfactory. Night flying has produced two crashes.

Night vision score—0/32. At a second test three months later, he scored 3/32.

GENERAL CONSIDERATIONS

The Night Sky.—It may be said that at moderate altitudes, provided visibility is unrestricted by mist or cloud, there is always some residual light against which to compare the silhouettes of aircraft. It is wrong to maintain that vision in the night sky corresponds to the

state of dark adaptation so well known in connexion with laboratory studies, and therefore the expression 'dark adaptation' should be superseded by the term 'night visual capacity'—a very different problem. The range at which the detection of aircraft becomes possible is influenced by the position of the observer in relation to the highest background brightness, such, for example, as looking away from the moon, or looking in close proximity to it. It has been estimated, and

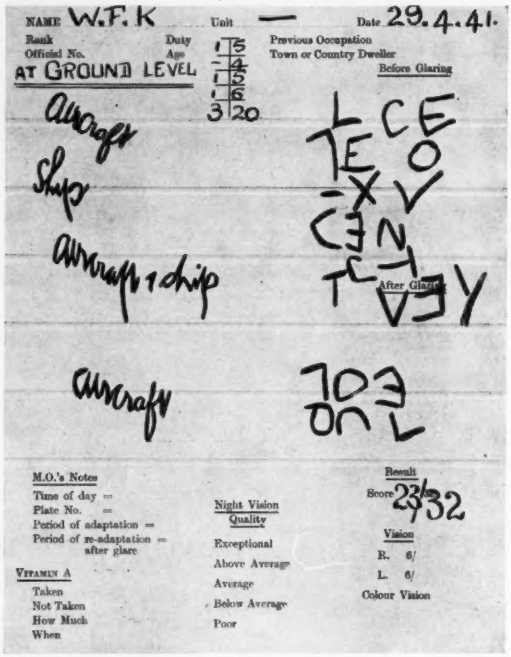

FIG. 291.—This represents a score at ground level of 23/32, which is in the "above average" group.

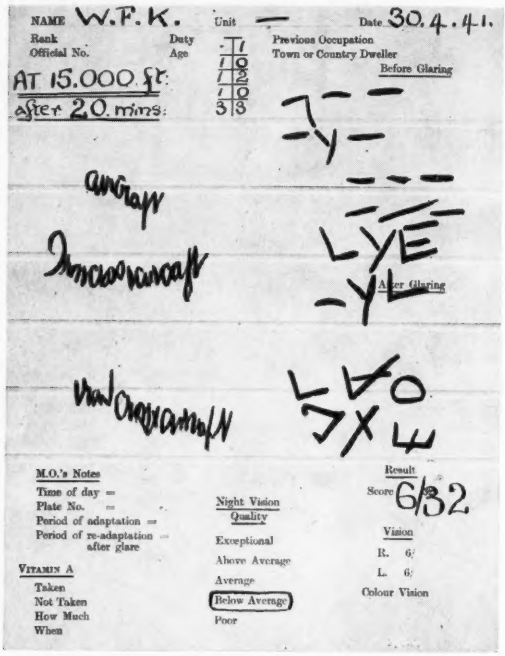

FIG. 292.—This shows the effect of oxygen want upon night vision in the same subject as in *Fig.* 291, but after remaining for 20 mins. at 15,000 ft. in the pressure chamber. Two points should be noted, namely, failure of vision at low light values, and a characteristic crowding together in the handwriting, together with wrong spelling and reiteration.

is now generally accepted, that the capacity of the human eye to see in the night sky under optimum conditions varies in distance from 1000 feet to three miles or more. One has, for example, spotted an aircraft in summer, flying north of Lincolnshire, at a range estimated at four miles. This was effected from an altitude of only 5000 feet, the time being midnight, and the aircraft observed representing a black spot moving across the face of the sun's afterglow. Sky brightness measurements were compiled by Stiles, 1937.

The Influence of Oxygen Upon Night Visual Capacity.—It has been shown that the use of oxygen for night flying is a matter of the greatest importance. Experiments have revealed that where oxygen has been withheld, night vision is impaired even at relatively low altitudes. At higher altitudes—for example, 16,000/18,000 feet—other adverse effects add to the visual disturbance, so that both vision and capacity to act become blunted (*Figs.* 291, 292).

Visual Preparation for Night Flying.—As the process of dark adaptation takes one hour to reach its highest peak of efficiency, consideration has been given to procedures by which it is possible to prepare the eyes before taking off. There are two methods available by which this can be done. In one, the air-crews can be retained in a dark room; in the other, they can be given dark goggles of low light transmission to wear. The first method is open to many objections, among which the most important is the risk of the transfer of upper respiratory ailments, and the natural disinclination in active subjects to be confined in complete inactivity for a period before flying. The method of using dark goggles overcomes these objections. It is possible when wearing them for air-crews to move about freely in ordinary artificial light, while at the same time a satisfactory process of adaptation is going on.

SUMMARY

1. The examination of night visual capacity can be conducted by employing a single and simple stimulus where, for example, a survey of nutrition in respect of vitamin-A deficiency is being undertaken; or by a complicated stimulus, involving fuller analysis, and effective response, for such purposes as the examination of night flying personnel.

2. The instrument designed to embrace the night operational problems of the Royal Air Force is described.

3. Notes are included which touch upon conditions encountered in the night sky, and the effects of oxygen want upon the capacity to see under states of threshold luminosity, and minimal contrast.

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CRITICAL REVIEW

THE TREATMENT OF ACUTE APPENDICITIS

By H. H. RAYNER

SURGEON, MANCHESTER ROYAL INFIRMARY

ACUTE appendicitis continues to attract the undiminished attention of the surgeon, and this it deserves, for it constantly provides a test of his ability as a diagnostician, unassisted by the promptings of an X-ray examination, of his skill as an operator, and of his resourcefulness in after-treatment; further, it has taught him much of what he knows about peritoneal infection.

The treatment of acute appendicitis before perforation has occurred is dealt with summarily in recent literature, for surgeons all over the world agree in the unhesitating advocacy of immediate appendicectomy. Indeed, a review of the literature might finish at that statement, but the opportunity may be taken to renew our conviction of the wisdom of this practice by pointing out that if we compare the operation for removal of an acutely inflamed, perhaps gangrenous, but unperforated appendix with any other important operation in respect of safety, rapidity of recovery, the certainty with which the course of a treacherous disease is arrested, and the assurance it confers of freedom from similar attacks in the future, it can be claimed that probably no other operation secures so much with such a small amount of surgical interference. The only conditions to be observed in the application of this well-founded practice are that the diagnosis must be reasonably clear and that the patient's hold on life has not been greatly weakened by some other serious disease, e.g., severe bronchitis, pulmonary tuberculosis, and cardiovascular degeneration. Great obesity of the patient, too, may well justify the surgeon in pausing to balance all the circumstances. Neither old age nor early childhood contra-indicate the operation; indeed, several writers regard these ages as reasons for strongly urging immediate operation.[1, 2] So too pregnancy, even in its later stages, is considered by all who have written on this association as a particular reason for the performance of the early operation.[3, 4] A consideration of the difficulties and pitfalls in the diagnosis of the disease is outside the scope of this review, but the opinion may be expressed that it is the failure to preserve an open mind, a failure so difficult to avoid when faced with the apparently commonplace, which is responsible for a large proportion of the errors in the diagnosis of the disease. The old dictum of "quick in and quicker out" has long been obsolete; always there is time to make a considered diagnosis as there is to do a careful and gentle operation.

The whole purpose of the operation is the extraction of the intact appendix without allowing the slightest escape of its contents, and if the appendix should be a mere gangrenous bag crammed with the most fœtid contents and fixed in an awkward position much time and patience may be required to do this. The time and patience are well spent, for on clean removal depend the smoothness, comfort, and rapidity of the patient's recovery as well as the reduction of risk to life to a negligible fraction; these, after all, are the tests to apply to our work.

APPENDICITIS AFTER PERITONEAL INFECTION

The treatment of acute appendicitis after the occurrence of a manifest peritoneal infection, the result of rupture, perforation, or even bacterial seepage, has aroused a great deal of discussion and controversy in the last ten years. To appreciate the points at issue it must be remembered that almost throughout the surgical lifetime of appendicitis there have been a few surgeons who have advocated avoidance of immediate operation for appendicular peritonitis and, in place of active surgery, the institution of a plan of treatment designed to help the infection to subside or to localize and, in the event of abscess formation, to deal with this by simple drainage. A. J. Ochsner[5] in 1902 was probably the first, and certainly the strongest, advocate of this policy. He insistently advised, whilst recommending immediate operation for unperforated acute appendicitis, that after the onset of peritoneal infection the patient should not be operated upon unless an abscess formed, that treatment must comprise absolute prohibition of all nourishment by mouth—even sips of water were not allowed during the first one or two days—of cathartics, and of large enemata; the employment of gastric lavage for vomiting, or if the stomach was believed to contain food, he regarded as most important, and to facilitate this he used a 2 per cent cocaine spray. He sought to maintain the patient's vitality by small nutrient enemata composed of 3 oz. of saline solution and 1 oz. of predigested food. He always advised an interval appendicectomy some weeks after recovery from

the acute attack. He claimed that this treatment was very much safer for the patient, particularly for one with evidence of diffuse or general peritonitis, than immediate operation, which, he stated, before his conversion he regularly practised with discouraging results. No one can read Ochsner's book without being impressed by the strength of his conviction in making this claim, but he does not appear to have received much support from his own countrymen until recent years, though in this country Sherren[6] in 1905 wrote rather hesitatingly in favour of avoiding operation in patients seen "more than 36 hours after the onset"; twenty years later, however, Sherren[7] strongly advocated the avoidance of immediate operation whenever "the disease was no longer confined to the appendix" and advised a line of treatment similar to Ochsner's, though not quite so rigorous. McNeill Love[8] and Hamilton Bailey[9] have each advised discrimination in regard to immediate operation, the former advising delay in patients with local peritonitis though he recognizes that the surgeon's hand may be forced a day or two later, whilst the latter regards the duration of the history as the deciding factor in the selection of patients for immediate operation, with the reservation that under certain specified conditions the duration of the disease should be ignored in arriving at a decision. But apart from these dissentients it may fairly be said that during the years from 1905 to 1930 the established practice in Britain, Europe, and America has been to operate without delay in all types of appendicular peritonitis; the only exception to this has been in the treatment of the mass or infiltration, the late result of localized peritonitis, and in this a number of surgeons otherwise orthodox have advised a period of observation unless the mass was in fact an obvious abscess.

The published mortality rates of immediate operation for spreading, diffuse, and general peritonitis, considering these in one group as precise distinction is not possible, range from 8 per cent to 35 per cent or even 40 per cent. It may here be remarked that this mortality rate is decidedly higher in the experience of several American surgeons than it is in any of the recorded results of British surgeons, and this may well have persuaded those who have experienced the higher rates to try different methods. For more than twenty years appendicitis has each year caused more deaths per million of the population in the United States (at least in those states whose mortality tables are available) than it has in England and Wales. The annual number of deaths from this cause per million in the United States ranges from 120 to 160, whilst in England and Wales the corresponding figure remains fairly steady around 70. It is very probable, then, that the disease is commoner in the States than in England, but it is possible that a higher proportion of graver types may account for some of the difference. Whatever the explanation, the tendency to advocate conservative methods in appendicular peritonitis is a striking feature of American literature during the past ten years, though it is probable such advocates are in a decided minority in their own country, whilst there is little evidence, beyond that already mentioned, of a similar movement in Britain or on the Continent.

Undoubtedly an incentive to this revival of conservatism has been the improvement in our methods of dealing with dehydration by continuous intravenous administration of saline solution and with distension and regurgitant vomiting by the use of an inlying fine stomach or duodenal tube. Some of the advocates of conservative treatment would apply it to all patients after the onset of peritoneal infection, whilst others would limit it to the patient with diffuse peritonitis who is seen for the first time between the third and sixth day of illness—the so-called danger period. This danger period calls for a brief digression, for stress is laid on it by many writers who because operation is comparatively safe before and after that period argue that the patient with peritonitis who when first seen is within that period should be tided over it until the safer days are reached. Surely the danger period is one in which the surgeon is dealing with a selected group of patients composed mainly of the most serious types. The selection is made in this way: a fairly large proportion of patients are not seen in the early stages by the surgeon; such patients may not have called a doctor, or if they have they persuade him to wait and see, a request not easily opposed when there is a history of similar attacks in the past followed by natural recovery. All of these miss the ideal time for a safe operation; a proportion of them do in fact settle down and are therefore not seen by the surgeon; others appear to be settling down, or at any rate are not obviously getting worse, and of these many eventually come to the surgeon after the first week with a mass, but in fairly good general condition. Those who are seen by the surgeon during the third to sixth day are the ones who are manifestly deteriorating and whose condition has so aroused the anxiety of relatives and doctor that the advice of a surgeon is insisted upon. Very many in this last group have widespread peritonitis.

It is claimed by the surgeons who practise the modernized Ochsner treatment that their mortality rate in spreading and diffuse peritonitis has been greatly reduced, sometimes more than halved, since they adopted it. The following extracts are examples of these claims:—

Bower[10] records 98 patients with "spreading peritonitis", 52 of whom were operated upon immediately with a mortality of 15 per cent, and in the remaining 46 operation was delayed for several days—the average period of delay was 8 days—with a mortality of 6·5 per cent. It is not precisely stated whether the whole series was composed of consecutive patients—presumably it was, otherwise the method of selection should be described. Apart from the

timing of the operation the two groups were treated in exactly the same way, by the continuous intravenous administration of saline and dextrose solution and the intramuscular injection of *B. welchii* serum in full doses.

Stanton[11] records a series of 1004 patients all operated upon by himself or one associate; of these 113 presented well-marked "evidence of peritonitis during the high mortality period of the disease (third to fifth day)"; 31 of this group were operated upon at once with a mortality rate of 42 per cent, and 82 were treated conservatively until symptoms had subsided and were later operated upon with a mortality of 8·5 per cent. "The cases operated upon immediately were none of them considered to be particularly bad risks at the time, whilst the more desperately ill cases were not operated upon at once and are therefore included in the 82."

Coller and Potter[12], in writing of their experience before 1930, remark on the very low mortality following operations for unperforated appendicitis and for early local peritonitis and on "the shockingly high" mortality following operations for spreading peritonitis during the third to fifth day of the illness. Following this experience they abandoned immediate operation for spreading peritonitis and the mortality rate in a series of 85 patients with this complication then fell to 9 per cent; of the 77 who survived, the peritonitis subsided without operation in 29 and an abscess developed in 48. In a communication some 5 years after the foregoing, Coller[13] strongly upheld the policy of deferring operation for spreading peritonitis "until the dehydration, hypochloration, and ketosis were corrected".

Bunch and Doughty,[14] on the treatment of patients with diffuse peritonitis, write "Those patients when first seen on the fourth or fifth day after onset hang literally between life and death; operation upon them too often only hastens the end. In an adult ¼ gr. of morphia should be given every three hours if the respirations are more than 15 a minute, continuous duodenal suction, and an abundance of intravenous saline with glucose and insulin. The use of oxygen may be life-saving. Although some patients under this treatment die of progressive sepsis, they must also have died from operation, and there is the assurance proved by the experience of an increasing number of surgeons that conservatism in this critical period results in a lower mortality rate."

Walker[15] states that of 5371 patients admitted to the Boston City Hospital with appendicitis 107 suffered from general peritonitis, and of these a series of 77 were treated by immediate operation with a mortality of 42 per cent, and in the next 30 patients the operation was deferred and with a mortality rate of 13 per cent. In the group submitted to immediate operation it is noted that 14 of the 32 deaths occurred within 24 hours following operation. In the deferred operation group the average time from admission to formation of the first abscess (one patient had five abscesses) was four days.

In assessing the evidence in favour of delaying operation it is hardly necessary to observe that statistics relating to the treatment of appendicular peritonitis must be viewed with a very open mind; the criteria on which the classification of the types of the disease is based depend largely on the judgement of the surgeon and cannot in any case be determined with any accuracy in the absence of the direct evidence afforded by immediate operation. On the other hand, it will be observed that the groups used for contrasting the results of immediate and delayed operation have been in the hands of one surgeon and that selection of patients does not appear to have been employed. There is of course a well-recognized tendency for a surgeon to ascribe his good results to some particular detail in technique which he has recently adopted but which is not in general use and for him to show by statistics that his results have notably improved since the adoption of the measure; sometimes the conclusion he draws is directly opposed to that arrived at by another surgeon, yet supported by the same processes of reasoning; an example of this can be found in papers dealing with drainage in appendicular peritonitis. Some such considerations may well be in the mind of the reader of the foregoing extracts, but even so the cumulative effect of the testimony from so many experienced surgeons is impressive and can hardly be dismissed as arising from misinterpretation of clinical experience or wishful thinking. It does seem to the reviewer that the method is worthy of trial in the patient who, when first seen three to five days after onset, has a widespread peritonitis and whose condition is such that recovery by means of operation is in great doubt. Those who cannot believe that Ochsner's treatment in such a case offers any better if as good prospects of recovery might well consider the possibility of improving the patient's condition by so treating him for 24 to 36 hours before operating; Walker's observation that of 32 deaths after immediate operation 14 occurred within 24 hours of the operation suggests that the imposition on an already toxic and dehydrated patient of the ill effects of anæsthesia and the additional systemic infection through the wound had served to accelerate death. But it does appear that no case has been made out for treating the early stages of peritonitis, whilst the infection is still local though not localized, in this way; at this period the results of immediate operation by a competent surgeon are so very good that any set policy of delaying operation would seem to expose the patient to an unnecessary risk and the surgeon to an unnecessary burden of anxiety.

Very little reference has been found in this controversy to the fulminating type of appendicitis, in which the patient may present evidence of widespread peritonitis (due to sudden and complete obstruction of the appendix, rapidly culminating in its rupture into an unprepared peritoneum) within 6 to 24 hours of the first symptom. It is probable there are few, if any, surgeons who would apply conservative treatment to this type, yet it does not appear to be recognized by the advocates of conservative treatment of peritonitis as a distinct though uncommon type which calls imperatively for operation at once if the patient's life is to be saved. So, too, writers who particularly deal with the disease in early childhood,[2, 9] in the elderly[1] and during

pregnancy, [3,4] without exception emphasize the need for immediate operation in spreading and diffuse peritonitis in any one of these states.

The treatment of the patient who in the course of an acute attack presents a mass at one of the appendicular sites has also revealed a considerable divergence of opinion as to the advisability of immediate operation. It will help to clarify the position if we recognize that there is more than one kind of appendicular mass; for example, there is the mass met with about the end of the first week of illness, usually to be seen as well as felt, which is an obvious abscess and about the treatment of which there can be no dispute. There is the mass produced by the recent localization of peritonitis which may have formed on or soon after the second day of illness and which is by no means easy to feel because the overlying muscles are still rigid; indeed the existence of such a mass may escape detection until relaxation by anæsthesia (for the operation) has been obtained. In the treatment of this type it is probable the great majority would practise immediate operation, and provided the practice is not enforced without discrimination few would disagree. But if the patient is clearly a bad subject for an urgent abdominal operation, especially for this one which opens up a localized intraperitoneal infection, then the experience of Sherren,[7] McNeill Love,[8] Sworn and Fitzgibbon,[16] and others in conservative treatment of localized appendicitis should be kept in mind. These surgeons found that a considerable proportion of such cases cleared up under conservative treatment; in McNeill Love's experience 65 per cent resolved, 25 per cent formed an abscess, and in 10 per cent a forced operation was done, because of increase in severity of symptoms; the mortality rate in the whole group was 3 per cent.

Lastly, there is the mass met with at any time from the fourth or fifth day to two or three weeks after onset. This mass may be extensive or quite small, is hard and not particularly tender, it is usually well-defined, though its outlines may be obscured by induration of the abdominal wall. It is the ambulatory patient who is so likely to display this lesion, for his attack has been a mild one and has therefore been neglected. The lump is produced by the agglutination of the swollen and indurated ileo-cæcum, mesentery, omentum, and frequently the overlying parietes around a turgid and friable appendix which, embedded in the depth of the mass, is often unrecognizable at operation. There may be a little pus, sometimes with a loose concretion, around the appendix. Continental and American surgeons, more than their British colleagues, distinguish this type of mass from the obvious abscess and define it as an infiltration. As the mass may ultimately be converted into an abscess it follows there are intermediate types, and in these there may be doubt whether the swelling is due to the conditions described or to accumulation of pus; a short period of observation will usually dispel the doubt. The majority of Continental and American writers agree in advising the avoidance of operation on the infiltration type until the response to non-operative treatment—the most important item in which is absolute rest without any concession—has been observed, but one or two of them specifically recommend immediate operation on the ground that it is unsafe to draw any distinction between the various types of appendicular masses. British writers seldom record the infiltration as a distinct type, but include it in one large group described either as localized peritonitis, appendicular mass, or abscess; indeed this inclusion is probably responsible for a large proportion of the successes claimed for the conservative treatment of localized peritonitis. Whatever may be our views on the treatment of localized peritonitis in its various manifestations, surely it is unsound to declare strict allegiance either to the doctrine of routine operation or to that of conservatism; for our aim should be to secure the very real advantages of conservative treatment for the suitable patient without exposing the unsuitable to its risks, and safety in the selection may be achieved by a clearer recognition of the different types of peri-appendicular swellings and their clinical features.

Some reference must be made to details in technique of the operation and after-treatment, for these in practice may determine the issue between life and death.

The Incision.—In the last decade it would seem the great majority of surgeons have adopted a direct approach through a right iliac incision, and of incisions in this position, though several have been described, the McBurney remains much the most popular, particularly in America. It is certainly very satisfactory for the early appendix in the iliac fossa, but much less satisfactory for the appendix fixed deeply in the pelvis or in the retrocolic position. For the appendix in the latter position the Rutherford Morison incision gives better access, at the price of muscle cutting, than any other; it has recently been well described by Saint.[17] Battle's incision is advocated by several British surgeons, but does not appear to be used much abroad. Colt and Morrison[18] have given statistical evidence in support of it. The paramedian incision, by rectus slide, is mainly advised for use when the diagnosis is in doubt, but, lest such advice should appear to condone slackness in arriving at a diagnosis, let it be admitted that no single incision can provide adequate access to every mimic of appendicitis. The paramedian incision is also employed with advantage when the appendix is pelvic in position and the patient is bulky. Incision for abscess, it is generally agreed, should be so placed as to give the most direct access for evacuation and drainage and that when an

extraperitoneal approach is possible, as to the abscess in retrocolic or deep pelvic position (through the rectum), this should be employed.

Drainage.—The tendency to avoid drainage of the peritoneal cavity after operations for spreading peritonitis, so noticeable some ten years ago, does not appear to have grown, though a few recent writers do claim better results after complete closure of the peritoneum. The majority of surgeons, it appears, advocate drainage of the appendicular bed and of the pelvic cavity if this should contain a distinctly purulent effusion, though several regard the insertion of a tube from wound to floor of pelvis as a doubtful safeguard against the formation of an abscess in Douglas's pouch. No mention can be found of the management of the drainage tube in the after-treatment, and from personal observation it would appear that this is largely governed by rule of thumb. Some surgeons advise drainage only if the pus has an offensive smell—this would seem an unreliable guide, for in a predominantly streptococcal infection the pus may be odourless yet very virulent.

Distension and Ileus.—Distension of the abdomen if pronounced when the patient is seen for the first time is often regarded as indicative of a diffuse or general peritonitis; yet marked distension may be due purely to a local obstructive lesion of the lower ileum should this become implicated in the shutting-off of an abscess. A loop of bowel employed in this way to limit and enclose suppuration will inevitably suffer a temporary arrest of function and even some mechanical interference. A patient with this type of distension (local inflammatory ileus), though sunken-eyed and dehydrated, for vomiting is a feature, shows a pulse-rate usually below 100 and his pain is distinctly colicky in nature—a spasm may reveal visible and audible evidence of peristalsis. Such a patient will benefit greatly by continuous administration of intravenous saline and by systematic aspiration of stomach contents; enemata and administration of peristaltic stimulants meantime should be avoided. In 36 or 48 hours the patient's condition will have materially improved and if the abscess has been located he is in a much better position to undergo the necessary operation. It is possible that some of the patients classified as recoveries from general peritonitis under non-operative treatment (until occurrence of abscess formation) were really suffering from this kind of ileus and not from widespread peritonitis.

The treatment of the patient whose distension is due to diffuse peritonitis has already been discussed, but reference may be made to the ileus accompanying it. Inhibition and distension of the bowel in this condition is due to inflammatory infiltration of the bowel wall and the length of bowel affected corresponds to the extent of its exposure to the infective exudate; a much greater length of bowel is therefore involved than in ileus arising from abscess, but the interference with function is probably not so severe. During the performance of the operation (for diffuse peritonitis) several surgeons have practised drainage of the lower ileum, either by ileostomy or by passing a catheter through the stump of the appendix and then threading it through the ileo-cæcal valve into the ileum, and ascribe their favourable results to this practice. Handley[19] appears to have been more logical when he carried out an anastomosis between the upper jejunum and the transverse colon in the course of operations on 5 patients (4 of whom recovered) with ileus from widespread peritonitis. These measures are evidently based on the view that ileus is an important factor in causing death from peritonitis. The present-day methods of countering dehydration, upper intestinal distension, and, it might be added, the growing ability of the surgeon to control severe local and systemic infections, must modify our attitude to these mechanical methods of relieving diffuse inflammatory ileus.

Post-operative ileus arising some 3 to 7 days after operation may occasion great anxiety. Usually it is of the local inflammatory type, one or more loops of bowel having become tethered down to the appendicular bed or abscess wall. The tentative treatment of this complication is now well established—continuous intravenous administration of saline and the insertion of a fine stomach tube for frequent aspiration are regarded as vital in the treatment of pronounced post-operative ileus. Some surgeons employ peristaltic stimulants—of which acetylcholine is probably the most used—in all types of ileus, whilst others reserve these for the treatment of paralytic ileus and prefer the use of morphia in small repeated doses for the inflammatory ileus. The placing of the patient in an oxygen tent containing a high concentration of the gas—90–95 per cent—has been strongly recommended by several American surgeons[20] for the relief of post-operative ileus; it is said to promote deflation of the bowel and that it is a measure to be tried before considering resort to operation. In a proportion of patients with post-operative ileus the treatment outlined, though it improves the patient's condition, does not prove effective in the restoration of bowel function; intestinal fluid is aspirated from the stomach in undiminished quantities, there is no satisfactory expulsion of flatus from the rectum, and often there is visible and audible evidence of peristalsis. The question of operation then becomes acute, for though the possibility of obstruction by strangulation can almost be excluded yet the patient's vitality cannot be maintained for long under such artificial conditions. These resistant types are almost always due to fixation of the bowel in the infected area resulting in acute angulation or torsion, and the obstruction is only made complete by the gross dilatation of the bowel above the lesion from the accumulation of gas and fluid. The essential purpose of operation, then, is drainage, but not complete diversion, of the

intestinal contents above the obstructing lesion; an object achieved by simple enterostomy of a self-closing type, e.g., the Witzel, in the most accessible distended coil of small intestine. The majority of surgeons practice this operation for post-operative intestinal obstruction and resist the temptation to separate recent and vascular adhesions at the site of the primary operation. The mortality of the operation evidently varies widely, but it is probable that at least 6 out of 10 patients can be rescued by its timely and careful performance. Wevill and Wallace,[21] in a comprehensive review of 8265 patients submitted to operation by a number of surgeons for acute appendicitis, mention 50 patients who later required enterostomy for obstruction and only 2 of these survived. On the other hand, Holman,[22] in a very clear account of his own experience, mentions 7 patients submitted to enterostomy for obstruction, and of these 5 recovered; the writer's experience in this respect tallies pretty closely with Holman's.

The Use of Antitoxic Sera.—The most commonly used serum in appendicular peritonitis is that antagonistic to *B. welchii*, but anti-streptococcal and anti-*B.-coli* sera have also been used generally in combination with the first. Certainly there is no agreement amongst surgeons about the value of such sera and only a few British surgeons make any reference to their use, but many strong advocates can be found amongst Continental surgeons and a few amongst those of America. The subject has recently been well reviewed by Harvey and Meleney,[24] who conclude: "In view of the heterogenous nature of the reports it must be admitted that the value of serum in the treatment of peritonitis is not yet proved, although it is significant, we believe, that the reports favouring its use outnumber the adverse reports by almost 6 to 1. The subject deserves to be investigated further experimentally".

Sulphanilamide Therapy.—It is not possible yet even to form an approximate estimate of the position of sulphanilamide and its derivatives in the treatment of appendicitis, but it is clear from the number of papers which have appeared that the drug is being used extensively in the post-operative treatment of suppurative appendicitis. There is no indication for its use after operations for unperforated appendicitis, nor any justification for its trial as an alternative to operation in a 'wait and see' attitude. It seems likely, however, that it may be used by those who practice conservatism in diffuse peritonitis in conjunction with the measures they already employ. All who write on this form of therapy claim a reduction in mortality rate since they began to employ it or state their clinical experience has impressed them with its value. It is indeed probable that more prolonged experience of sulphanilamide may show that it has a much more decided value than has the administration of any known antitoxic serum.

The reader who wishes for detailed information on the subject is referred to papers by Ravdin et al.,[24] by Corry and Brewer,[25] and by Cokkinis.[26]

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SHORT NOTES OF RARE OR OBSCURE CASES

AUTO REDUCTION EN MASSE OF AN INGUINAL HERNIA

By G. G. COOLEY

Reduction en masse is one of the rarer complications of forcible manipulation of an inguinal hernia, and also one of the gravest, as it almost inevitably causes strangulation of the hernial contents.

The condition is most commonly the result of attempts at reduction by the doctor or by a friend; more rarely it is due to the manipulations of the patient himself. Reduction en masse due to the patient's own efforts has been termed auto reduction en masse (Walsham,[1] Grey Turner[2]).

The condition of reduction en masse was described as early as 1702 by Saviard,[3] and in 1931 Pearse[4] reviewed the literature and collected 193 recorded cases. Nason and Mixter[5] in 1935 published 5 cases, and Wolff[6] in 1939 added a further case. The following is an account of a personal case of auto reduction en masse.

CASE REPORT

History.—The patient was a man aged 36, and had had a reducible right inguinal hernia for over five years and controlled it with a truss. Six hours before admission, he was at work, and felt his hernia slip down. He pushed it back, readjusted his truss, and carried on with his work. Half an hour later, there was a sudden onset of severe central abdominal pain which was colicky in type, and this was followed by vomiting.

His bowels had moved that morning before the onset of the pain, but since then he had had no bowel action and had not passed flatus.

He gave no history of dyspepsia and had had no previous operations.

On Examination.—The patient was in obvious pain, which was referred to the umbilical region. The abdomen moved freely on respiration and showed a definite diffuse tenderness. Just above the right inguinal ligament a tender mass was present, and the right inguinal canal was empty.

Borborygmi could be heard on auscultation, and these were associated with exacerbations of the colicky pain.

No abnormality was detected per rectum. The temperature was 98·6° F.; pulse, 88; respiration, 20.

Operation.—Under general anæsthesia, the abdomen was opened by a right paramedian incision, and in the region of the right internal inguinal ring there was a mass of bowel bulging upwards into the peritoneal cavity. The neck of the hernial sac had been thrust into the peritoneal cavity, the sac itself being drawn upwards and inwards, and in doing so, the constricting effect of the neck of the sac had been increased, and strangulation had resulted (*Fig.* 293).

The bowel was easily released and was viable. The inguinal canal was then opened, the sac everted down the inguinal canal, and a Bassini's type of repair performed. Convalescence was uneventful, and the patient was discharged three weeks later.

Comment.—The clear history, and the fact that the hernial mass could be palpated as it projected into the peritoneal cavity above the inguinal ligament, made the diagnosis straightforward. For the hernial mass to attain this position several conditions are necessary: viz.,

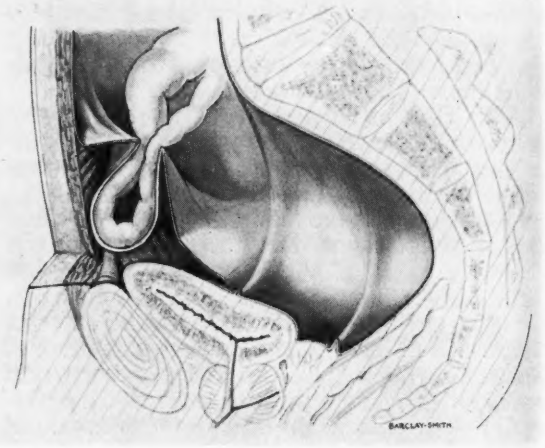

Fig. 293.—Auto reduction en masse. Drawing showing the operation findings.

a mobile sac, laxity of the tissues between the internal inguinal ring and the anterior peritoneum, and mobility of the sac itself.

If the neck of the sac is fixed, however, the reduced mass will occupy either the properitoneal pouch, or will be displaced into a retroperitoneal position; or, if the force is extreme, rupture of the sac may occur and the contents will be displaced extraperitoneally.

The symptoms in this case occurred within half an hour of the reduction, but in some cases symptoms do not appear for weeks or even months after the reduction.

I am indebted to Mr. C. M. Pearce for permission to treat and report this case.

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A CASE OF PRIMARY ACTINOMYCOSIS OF THE BREAST

By MAX PEMBERTON

SURGICAL REGISTRAR, ABERDEEN ROYAL INFIRMARY

THERE have been few cases of primary actinomycosis of the breast described, and still fewer where it has been possible to make the diagnosis before the breast was removed. According to Zachary Cope[1] only 8 or 9 undoubted cases have been reported. In the case recorded here the diagnosis was established before operation. Several interesting features in the history and clinical signs are also reported.

CASE REPORT

HISTORY.—Mrs. E. G., aged 41, the wife of an Aberdeenshire farmer, was first seen at the Out-patient Department on April 2, 1940.

She stated that at the beginning of October, 1939, while harvesting, an ear of corn became lodged inside her blouse. Later a prickling sensation drew her attention to a sharp grain of corn sticking into the nipple of the left breast, and she pulled it out. About ten days later she complained of soreness and stiffness in this breast. The breast became hard and the pain continued, especially at night. A lump in the left axilla appeared soon after, and it was painful to move the arm. There was no discharge from the nipple. In December, 1939, the skin became purplish and she sent for her doctor. The condition was thought to be an abscess, and the breast was incised, but the wound did not heal. The skin broke down in two other places, and the three sinuses discharged pus

FIG. 294.—Vertical section of breast in the plane of the nipple, showing subareolar and other abscesses.

and blood-stained fluid. These openings closed, but some time later they were again discharging. The lumps in the breast and axilla continued to become larger and the nipple became retracted. The painful mass in the axilla was her chief complaint when she reported at the Out-patient Department.

There was no history of any previous disease of the breast. Her general health had always been excellent and she had never had bronchitis or any chest trouble. She has had eleven children and nursed them all. They are all alive and well, and none of her relations has suffered from a similar condition.

There are a lot of cattle on the farm, but she has not heard of a case of lumpy jaw during the twelve years she has been there.

CLINICAL FINDINGS.—The patient was a thin woman of good complexion. Temperature and pulse were normal. There were some carious teeth. The heart and lungs were normal.

The Left Breast: This was enlarged and the nipple retracted. There were three sinuses, one discharging pus. A lump about the size of a cricket-ball was palpable in the central portion of the breast. The lump was indurated and slightly tender. It was

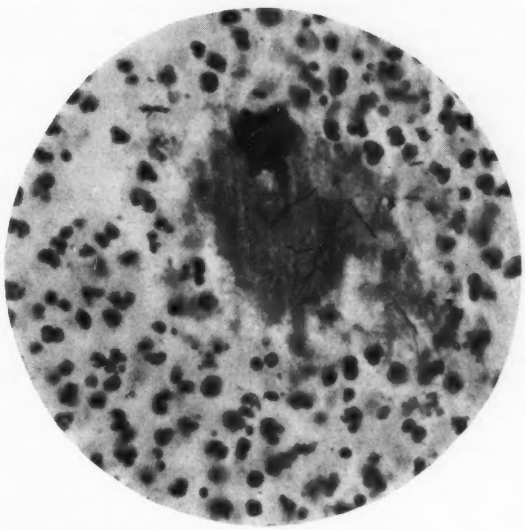

FIG. 295.—Colony of actinomyces surrounded by pus. (× 600.)

attached to the skin and to the pectoralis major muscle, but not to the chest wall. Several enlarged and tender nodes could be felt in the left axilla. General examination did not reveal any further abnormality. The patient was admitted to the Aberdeen Royal Infirmary on April 9, 1940.

SPECIAL EXAMINATION.—Pus from a sinus was sent for examination and a film stained by Gram revealed Gram-positive mycelial filaments of actinomyces, but a typical colony was not seen. No culture was made. Radiological examination of the chest showed no abnormality.

A diagnosis of primary actinomycosis of the breast was made and it was decided to amputate the breast.

OPERATION (April 11, 1940).—An elliptical incision was made to include nipple and sinuses. The breast was removed with a portion of pectoralis major muscle which appeared to be infiltrated by the mass.

The enlarged nodes in the axilla were easily dissected and removed. The axilla was drained through a separate incision and the wound closed.

SUBSEQUENT PROGRESS.—The patient was discharged on the seventh day. She was ordered potassium iodide. She was seen on Aug. 15, 1940, when the wound was healed and there was some œdema of the left arm. The œdema soon disappeared and she was perfectly well when last seen in January, 1941. There was no sign of recurrence.

PATHOLOGICAL REPORT (Professor Young, March 1, 1941). Serial No. A.R.I. 330/1940—Actinomycosis of breast.

Naked-eye Description of Specimen.—In the first instance the specimen was bisected through the nipple in a vertical plane. In this plane (*Fig.* 294) several abscesses were observed, the largest of them situated centrally and measuring one inch in diameter. The pus was creamy in consistence but had an orange tinge; it contained no visible 'granules'. The other smaller abscesses were independent formations and did not communicate with the larger central abscess or with one another. The interstitial tissue of the breast was indurated and consisted in part of translucent granulation tissue. This granulation tissue extended into the superficial part of the underlying pectoralis major, but otherwise the muscle was normal in appearance. A series of thin slices were cut through the breast parallel to the first plane of section. They showed a diffuse interstitial fibrosis associated with dilatation of the ducts which were filled with cheesy material as in a 'chronic obstructive mastitis'. In particular, it should be noted that no grain of corn or other foreign body was observed in any of the planes of section throughout the breast.

Histology.—The lesion is a subacute or chronic pyogenic formation. The first group of six sections revealed only a few Gram-positive filaments, but one typical colony of actinomyces was observed in a subsequent series of sections. This colony (*Fig.* 295) is surrounded with pus cells.

The dilated ducts, which were noted in the naked-eye specimen, are filled with a loose coagulum mingled with desquamated epithelial cells; no pus cells are present.

The enlargement of the axillary lymph-nodes is due to a simple reactive hyperplasia affecting both the reticulum cells and the lymphocytic elements. There is no evidence of a 'metastatic' involvement of the nodes.

DISCUSSION

Actinomycosis is not an uncommon disease in this corner of Britain, and one is always on the look out for it at out-patients' departments. Although sections of the breast after removal failed to show any evidence of a foreign body, it seems probable that the corn in the nipple had something to do with the start of the infection. No cultures were made from the pus, and it is therefore impossible to be certain of the exact type of infecting actinomyces.

The differential diagnosis lay between chronic suppurative mastitis and carcinoma. The simulation of scirrhous carcinoma was nearly perfect. The nipple was retracted, the lump densely hard, attached to skin and to muscle, and there were enlarged nodes in the axilla. The finding of the fungus in the discharge from a sinus clinched the diagnosis, but carcinoma and actinomycosis have been reported in the same breast.

There should be a routine examination of the discharge from all breast abscesses, although many attempts may be required to detect the actinomyces.

Although it is rare for lymphatic nodes to be affected in actinomycosis, a number of cases have been reported. The axillary nodes in this case had undergone a reactive hyperplasia, but they showed no sign of the actinomyces. If they are enlarged it seems reasonable, however, to remove them when the breast is amputated.

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SPONTANEOUS RUPTURE OF A HYDRONEPHROSIS

BY GEORGE LARKS

PLYMOUTH CITY GENERAL HOSPITAL

THE rupture of a hydronephrosis is an unusual occurrence, and most of the recorded cases have been traumatic in origin. In the case here recorded no traumatic factor could be elicited and the incident appears to justify description as the still rarer "spontaneous rupture".

CASE REPORT

HISTORY.—T. C., a male skilled dockyard worker aged 57 years, was admitted to hospital on Nov. 4, 1940, as an acute abdominal emergency case.

He stated that at about 11.30 p.m. on the previous evening, whilst lying in bed he experienced a sudden severe pain in the right side of the abdomen, passing into the right iliac fossa and into the right groin. The pain radiated also into the back and spread, too, across the abdomen. It was therefore fairly diffuse, but mainly right-sided. The severity of the pain was such as to cause him to send urgently for his doctor during the night. By morning the pain was considerably worse. He vomited once only, about half an hour after the onset. There was nothing of importance in his past medical history; in fact, he had "never been ill before in his life!"

ON EXAMINATION.—Eleven hours after the onset, his general condition was good. Temperature, 97·6° F.; pulse, 92. He was in obvious pain, for which he sought relief unavailingly by doubling up and changing position in bed.

The right abdomen was tender and rigid, maximal in an area bounded above by the transumbilical and below by the interspinous line. There was tenderness of a lesser degree in the right loin and right hypochondrium. Liver dullness was not diminished. Ward examination of the urine (sp. g. 1022) revealed no abnormality.

Three hours later there had been little alteration, but rigidity was now also evident in the right lumbar muscles, and the pain and tenderness were more marked in the right iliac fossa. No mass was palpable.

X-ray Examination (in view of the possibility of calculous ureteral obstruction).—No calculus was seen. Kidney outline was not evident. The colon was recognizable by its gas shadow, and although its possible importance was not recognized at the time, it revealed an unusually low position for the hepatic

flexure. The outer border of the psoas was obscured in its upper third.

Operation was advised on a diagnosis of (?) retrocæcal appendicitis, an opinion which was not held with any degree of confidence. Before opening the abdomen a cystoscope was passed on the anæsthetized patient. The examination was incomplete, but served the purpose for which it was undertaken, to ascertain that the right ureteric orifice showed no pathological changes.

Operation (15 hours after onset).—The abdomen was opened through a right paramedian incision.

Fig. 296.—Photograph of the specimen (*see* text).

There was an obvious effusion into the retroperitoneal tissues, extending into the mesentery of the small intestine. The incision was extended upwards and it then became apparent that the posterior abdominal tissues were waterlogged with a peculiar translucent œdema, obviously due to a spreading collection of fluid behind the peritoneum, most evident above and to the right of the hepatic flexure of the colon which was displaced downwards and medially. After isolation by packs a paracolic incision was made, and after a quantity of blood-stained watery fluid had been evacuated, the right kidney was found to be an incompletely collapsed sac. The left kidney felt normal; the right kidney was therefore removed by this transperitoneal route. The paracolic incision was sutured, the renal space being drained extraperitoneally through a loin drain. A suprapubic drain was inserted, as infection of the general peritoneal cavity was feared.

Progress.—His immediate post-operative condition was good, and his recovery uncomplicated. There was no infection of the wounds, and at no time any suggestion of peritonitis. The suprapubic tube was probably superfluous.

The Specimen (*Fig.* 296).—This consisted of a large hydronephrosis of about 1-pint capacity, the extrarenal pelvis being about 5 in. in its long diameter. Very little renal tissue remained. The three major calices were considerably dilated, the lowest showing the least degree of distension. At the ureteropelvic junction the opening was 'pin-hole', and the ureter below it, normal, and not dilated, was adherent to the bulging lower portion of the sac—a well-developed example of the congenital type of hydronephrosis. There was no calculus and no gross infection of the contents.

At the junction of the middle and lower calices at their entry into the kidney hilum was a rupture of the posterior wall of the pelvis, extending through all coats. It was $\frac{3}{4}$ in. in length, oblique—approximately radial in direction. To the edges of the rupture a little blood-clot adhered on the outer aspect.

The photograph was taken after fixation and subsequent trimming of the pelvis to remove obscuring tissue. The fixation has rather over-emphasized the edges of the rupture by making them appear inverted, and has correspondingly increased the width of the cleft.

DISCUSSION

The interest in this case lies primarily in its rarity. It is generally recognized that the distended pelvis of a hydronephrotic kidney renders it more susceptible to rupture by trauma, and most of the recorded cases have been traumatic in origin. Ball and Evans[1] state that spontaneous rupture is unknown. Abeshouse,[2] however, states that several cases of spontaneous rupture of a hydronephrosis have been reported. This divergence of view probably turns on the degree of trauma which occasioned the rupture. Quarry Wood[3] in 1923 recorded a case in which the rupture followed the muscular violence of jumping quickly into bed. It is possible that either the patient or the surgeon, or both, may overlook the mild external trauma or muscular violence that may produce a rupture in a grossly distended kidney. Yet it is well recognized that patients are not uncommonly encountered with renal swellings from hydronephrosis of considerable degree, of the existence of which they are unaware, and who continue their employment, sometimes of a heavy manual nature. In this case, the work of a skilled dockyard labourer might have been thought sufficiently severe to produce a rupture, which did in fact occur at rest. It is reasonable, therefore, to search for an accessory factor. The presence of a calculus may be such; in this case no calculus was found either within or outside the kidney, having escaped through the rupture. It is conceivable that a localized weakening of the wall might occur from infection apart from the presence of a calculus. Although there was no obvious infection of the contents of the hydronephrosis a section of the wall reveals microscopical evidence of inflammation at the site of the rupture. It is reasonable to suppose that where rupture occurs, with little or no violence, of a hydronephrosis that has previously withstood considerable violence, the secondary factor of localized pyelitis is aetiologically important.

Diagnosis.—The diagnosis is unlikely to be made, except in a patient known previously to have a hydronephrosis or an undiagnosed abdominal swelling. In the traumatic cases the most suggestive feature is that the degree of violence is too slight to rupture a normal kidney. The symptoms and signs are the result of a spreading infiltration of the perirenal and retroperitoneal tissues, and they bear a relationship to the rapidity of the spread and to the size and nature of the effusion. A considerable amount of fluid is likely to be extravasated fairly quickly, and the liberation of such a quantity of fluid may produce a swelling in the renal region or a fullness in the loin or upper abdomen, but this may be masked, as in this case, by the rigidity of the overlying muscles. Palpation under anæsthesia might therefore assist. Abeshouse draws attention to the diffuse character of the pain, more or less generalized over the abdomen, and soon becoming localized to the region of the kidney. Vomiting is usual, and flatulence, meteorism, and hiccup may occur, and eventually, if the patient survives sufficiently long, the symptoms and signs of abscess formation.

Urinary symptoms are uncommon and hæmaturia does not occur as a rule.

Most of the recorded cases have been undiagnosed or incorrectly diagnosed before operation, and in many, as in the case under review, the symptoms and signs are so urgent and so strongly suggestive of intra-abdominal mischief that laparotomy is advised. It has the advantage that when the true nature of the condition is revealed it allows the other kidney to be examined.

Treatment.—The treatment of ruptured hydronephrosis, whether traumatic or spontaneous, is nephrectomy when the condition of the other kidney will permit. If the diagnosis is made before operation, the lumbar route is the wisest choice. When the diagnosis is made by laparotomy, it may still be argued that the lumbar route is wiser, but time may be an important factor, and in early cases at any rate there appears to be no very real contra-indication to completing the operation by the abdominal route. The recorded cases are insufficient in number to enable a dogmatic conclusion to be reached.

Although nephrectomy is the method of choice, it should in the case of a severely ill patient be borne in mind that the important aim must be to drain the extravasation; the hydronephrosis may be left for secondary removal. Repairs of the rupture and plastic operations are contra-indicated on hydronephrotic renal pelves which have reached the stage of rupture spontaneously or from slight violence, and in the presence of extensive effusion.

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A CASE OF LYMPHOSARCOMA OF THE ILEUM

BY V. ZACHARY COPE
SURGEON TO ST. MARY'S HOSPITAL, PADDINGTON, AND TO THE BOLINGBROKE HOSPITAL
AND H. M. GRANT
SURGICAL REGISTRAR TO THE BOLINGBROKE HOSPITAL

THE following case is considered worthy of record as it displayed unusual features.

CASE REPORT

HISTORY.—A. C., aged 59, an electrician, complained of attacks of griping pain in the lower abdomen on and off for six years, which recently had become more frequent. He had never vomited, but had had a feeling of fullness after meals. His bowels had become increasingly constipated during this time, and he had been in the habit of keeping them open with purgatives, but he had noticed that these increased the pain. He had never noticed slime or blood in the stools. During the last two years there had been some loss of weight; about this he was rather indefinite, but thought it was about a stone or two.

Previous History: The only interesting points in his previous history were that he had been operated on for a duodenal ulcer in 1925, and for a double hernia in 1901. He had never been abroad and never had typhoid.

ON EXAMINATION.—His general condition was good, he was not cachectic, and showed no gross evidence of loss of weight. Temperature, 98° F.; pulse, 84; respirations, 20.

Alimentary System: Mobile lumps were palpable in the lower abdomen. There was no distension, no free fluid, no tenderness, and no visible peristalsis. The liver and spleen were not enlarged. By rectal examination, the rectum was empty and no fæcal masses were palpable.

Hæmopoietic System: No glands were palpable, and the blood-picture was as follows:—

Hæmoglobin	92 per cent
Red blood-corpuscles	4,950,000 per c.mm.
Colour index	0·92
Leucocytes	12,500 per c.mm.
Differential leucocyte count:—	
Neutrophil polymorphs	72 per cent
Lymphocytes	26 per cent
Large mononuclears	—
Eosinophils	2 per cent
Basophils	—
Abnormal forms	None

Genito-urinary System: For many years, he had had slight frequency of micturition, but recently this

had been better. He had had a right hydrocele and a left epididymal cyst, both treated by aspiration and injection of quinine-urethane.

Respiratory and Cardiovascular Systems: He had a slight irritable cough which he attributed to smoking. No abnormality was found on routine examination. Blood-pressure, 120–80.

AT OPERATION (Aug. 9, 1940).—Under gas, oxygen, and ether anæsthesia, laparotomy was performed through a left paramedian lower abdominal incision. A large tumour was found in the lower abdomen. This consisted of a mass of enlarged glands in the mesentery and a length of thickened ileum, of which the antimesenteric border was adherent to the bladder. About 2 ft. of intestine and the mesentery containing the enlarged glands were removed after separating the adhesion to the bladder, and the continuity of the remaining bowel was secured by a side-to-side anastomosis. The part of the bladder to which the tumour had been adherent was reperitonized by Lembert sutures.

THE SPECIMEN (*Fig.* 297).—The specimen removed consisted of about 2 ft. of small intestine. A length of about 8 or 10 in. of the bowel was converted into a hard rigid thick-walled tube. The thickness of the wall varied from 1 in. at the antimesenteric edge to 2 in. at the mesenteric border, with a lumen of about ¾ in. Immediately proximal there was an inch or so of dilatation, which might have been a mechanical accommodation between the normal bowel and the thick-walled tube. Proximal to this dilated section, the bowel was hypertrophied, suggesting that there had been some obstruction. Distally the bowel was normal.

Microscopical Appearance (*Fig.* 298).—The report made by Professor Newcomb was as follows: "The tumour is a lymphosarcoma. It has invaded all coats of the gut, with extensive ulceration of the mucosa; and there are large secondary deposits in the local lymph-glands.

"The predominant cell is the lymphoblast, with a few lymphocytes and an occasional reticulum cell. Mitoses are numerous in parts and scarce in others.

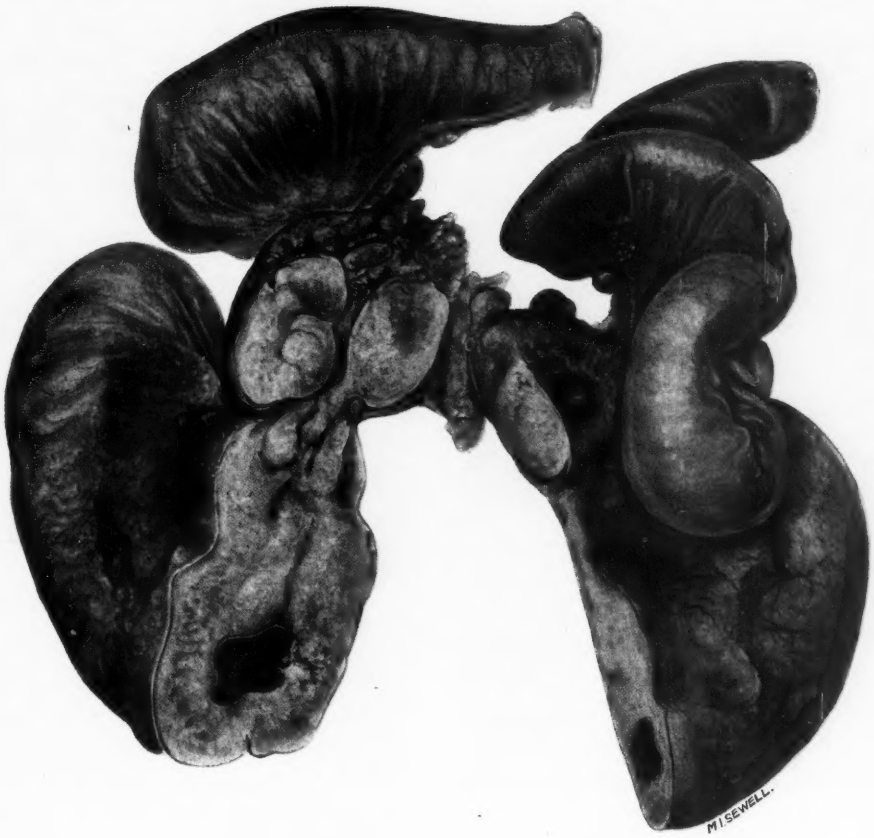

FIG. 297.—Drawing of the specimen.

"The stroma is also variable in amount; it consists mainly of collagen, with a small quantity of reticulum."

PROGRESS.—He was apyrexial during his pre-operative stage of a few days in hospital. Following operation, he developed bronchitis, with moderate pyrexia, but otherwise convalescence was uneventful, and during his last four weeks in hospital he was practically apyrexial again. Discharged Sept. 30, 1940.

He was given radiotherapy subsequently by Dr. Douglas Andrew at the Westminster Hospital.

At various times he reported for observation, and remained well and free from pain and gained weight. At one period it was thought that an indurated area could be felt on the posterior wall of the bladder by rectal examination, but on subsequent examination this seemed to disappear. A cystoscopy in March, 1941, showed no abnormality in the bladder.

When last seen in August, 1941, he was looking very well and had a distinctly ruddy complexion. No masses could be felt in the abdomen, and the liver and spleen were not enlarged. The blood-count was as follows :—

Hæmoglobin	108 per cent
Red cells	5,450,000 per c.mm.
Colour index	0·99
Leucocytes	8,900 per c.mm.
Differential leucocyte count :—	
Neutrophil polymorphs	58 per cent
Lymphocytes	39 per cent
Large mononuclears	1 per cent
Eosinophils	2 per cent
Abnormal forms	None

A radiograph of the chest, taken in May, 1941, showed some shadows, which it was thought might

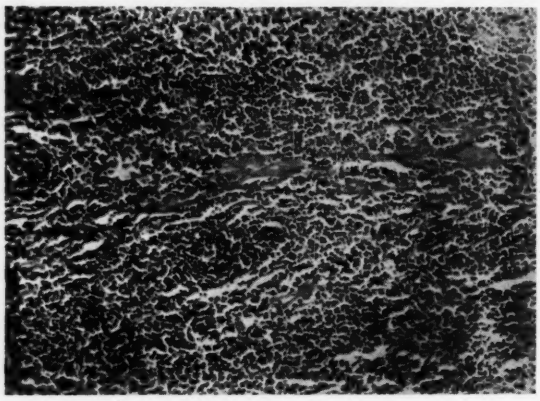

FIG. 298.—Microphotograph of a section of the growth showing the tumour invading the muscular coat of the intestine ; smooth muscle-fibres can be seen in centre of photograph. (*By courtesy of Professor Newcomb.*)

be secondary deposits, but a further picture taken in August, 1941, showed no change in the shadows, except, perhaps, some improvement.

Summary.—

1. A case of lymphosarcoma of the ileum is here described in a man aged 59.

2. With regard to aetiology, there was nothing in the history to which one could attach any significance.

3. The history of six years is a long one. The average duration of illness in recorded cases has been six to eight months, varying from a few days in very acute cases to ten years.

4. An unusual feature was the absence of cachexia.

5. The site was the most common one for lymphosarcoma of the small intestine—the ileum.

6. The macroscopical appearance, however, was not that of the reportedly most common type—aneurysmal dilatation—but that of the " rigid thick-walled tube " of Cameron's description.

7. The microscopical appearance was that of a lymphosarcoma invading all coats of the intestine.

8. *Prognosis* : The long history of symptoms would suggest a slow-growing tumour, and consequently a better prognosis. The possibility of there being secondary deposits in the lungs makes the outlook less promising, but secondary deposits in the lungs, however, are not common, as in Ullman and Abeshouse's series of 106 cases only 2 had secondary deposits in the lungs. The patient has, however, lived for a year, is very well, and shows no sign of recurrence. Of the 85 dead of Ullman and Abeshouse's cases, 55 died in the first two years. Of the ones that survived, however, it is recorded that 5 were alive as long as 7 years after, and others 8, 10, and 11 years after ; and Cameron records cases alive 8, 13, and 20 years after operation.

COMMENTS

Tumours of the small intestine occur much less frequently than tumours of the large intestine. The majority of tumours in the small intestine are benign ; Raiford reviewed 986 tumours of the gastro-intestinal tract, 88 of which were in the small intestine, and of these 50 were benign. Perusal of the literature would appear to show that :—

1. The ileum is the part of the small intestine most frequently affected by malignant tumours.

2. Sarcoma is the most common tumour found over the whole of the small intestine.

3. Lymphosarcoma is the most common variety, only 6·8 per cent being myogenous (Brink and Laing).

4. In the duodenum and upper jejunum carcinoma is more common than sarcoma.

The tumour said to be most typical by many authors is that described as ' aneurysmal dilatation '—" the tumour resembling a hollow sphere with a moderate degree of constriction at either end " (Raiford) ; Cameron, however, says that the frequency of this type is over emphasized, and adds, " a peculiar type of growth characteristic is the transformation of an appreciable length of small bowel into a hard rigid thick-walled tube ".

With regard to age incidence, lymphosarcoma is most common in the fourth decade of life ; it is, however, also very common in the first decade —Simpson Smith was able to collect 106 cases of sarcoma of the intestine occurring in childhood, 70 of which were in the small intestine.

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IRREDUCIBLE DISLOCATION OF THE ANKLE-JOINT

By R. SALISBURY WOODS
SURGEON SPECIALIST, E.M.S.

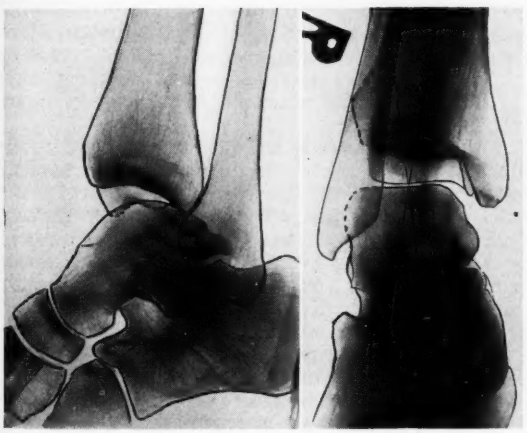
THE following case presented unusual, if not unknown, anatomical features. At any rate no record of such a displacement could be found in the literature.

CASE REPORT

HISTORY.—Second-Lieut. C. O. B. was admitted to Cambridge County Infirmary (E.M.S. Hospital) on April 23, 1941. While playing rugger on the previous day, this officer was tackled and fell, with his right foot plantar-flexed in front of him, twisting his ankle severely. He was unable to stand.

ON ADMISSION.—Some swelling, plantar flexion, and marked inversion of foot, but otherwise no gross deformity or obvious (antero-posterior) displacement. *Diagnosis*: Subluxation of right ankle-joint.

X-ray Report.—"Posterior dislocation of astragalus and foot on tibia. Posterior dislocation of fibula at lower tibio-fibular joint." (*Fig.* 299, A, B.)



A B

FIG. 299.—Radiographs taken on admission.
A, Lateral view; B, Antero-posterior view.

TREATMENT.—Prolonged powerful traction-manipulation of foot under anæsthetic failed fully to reduce: attempt abandoned.

X-ray Report.—"Position improved. Still some backward displacement of fibula and astragalus."

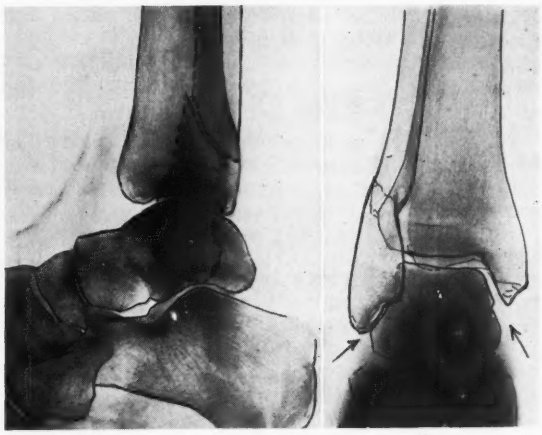
As different methods of attempted reduction, including continuous skeletal traction through the os calcis failed, it was finally decided to resort to open operation. Col. Max Page, who had been consulted, accepted an invitation to perform the operation. While the patient was under a general anæsthetic in the theatre, a last effort at manual reduction was made by Col. Page and the author but without any success.

Operation.—Oblique osteotomy of right fibula about 2 in. from lower end. Reposition effected. Radiography in the theatre confirmed: "The dislocation has been reduced." (*Fig.* 300, A, B.)

The reactionary swelling having subsided, the ankle was put up in a 'below-knee' walking plaster, and the patient walked in comfort.

PROGRESS.—The plaster-of-Paris splint was taken off after nine days. The wound had healed by first intention; the stitches were removed and the plaster re-applied. Five days later the patient could walk several miles a day in comfort and was sent home on sick-leave, to return in three weeks for removal of the plaster. July 17: Strapping support for ankle-joint. Movements good. Walks well. Discharged.

Commentary on the Mechanism of the Displacement.—It is evident that the lower tibio-fibular joint and all its ligaments must have been completely disrupted for the fibula to have shifted bodily backwards and become locked behind the lower end of the tibia. It would appear that the ligamentous connexions of the fibula with the astragalus (direct, and indirect via the calcaneo-fibular ligaments) remained intact, for the astragalus had been carried back with the fibula.



A B

FIG. 300.—Radiographs taken after open operation.
A, Lateral view; B, Antero-posterior view.

Presumably one large factor in the fixation of the lower end of the fibula in its new position must have been the rigid interosseus membrane locking the bones together in their new relative position and presenting an almost insuperable obstacle to reduction by a reversal of the process of migration.

Division of the fibula at the level shown in the radiograph must have freed the lower fragments from the tensile influence of the interosseus membrane attached to the shaft above, allowing this lower fragment to spring out again and come forward from behind the tibia into its normal position, and the astragalus thereby to regain its normal position in the joint.

Neither Keen, Böhler, Leriche, nor Watson-Jones mentions the condition, and no similar case could be found in several of the older books.

Böhler himself only records one case of dislocated ankle in which he was obliged to resort to open operation. (In this case, the tendon of the tibialis posticus had slipped across between the tibia and fibula).

My best thanks are due to Col. Max Page, Consulting Surgeon, Eastern Command; to Professor H. A. Harris, of Cambridge University Anatomy School; to Lt.-Col. R. W. Butler, now Surgeon i/c Cambridge Fracture Centre; and to Dr. F. R. Berridge, our Radiologist, whose repeated stressing of the posterior dislocation of the fibula was so fully justified.

A CASE OF RETROPERITONEAL HERNIATION OF IMPERFECTLY ROTATED COLON

By P. W. HOUGHTON

SURGEON LIEUTENANT, R.N.V.R.; SURGICAL SPECIALIST IN THE ROYAL NAVY

It has been argued by Andrews[1] that the formation of retroperitoneal herniæ is due to a developmental hitch and not to an alteration in the adult abdominal economy from pressure changes and other stresses. The discovery of a patient owning an obstructed hernia of malrotated ileum and colon incarcerated in Waldeyer's mesentericoparietal fossa, and the rarity of this cause of intestinal obstruction, has made an excuse for recording evidence in relation to this thesis and reporting this natural history.

CASE REPORT

History.—A seaman-cook, aged 24, serving afloat in the R.N. Patrol Service, was admitted to a R.N. Sick Quarters complaining of abdominal symptoms.

He said that he had suffered from recurrent epigastric pain since childhood, ever increased by food and especially pork and hard vegetables. Hospital treatment for peptic ulcer before the war and during his service experience had availed him nothing, and dyspeptic symptoms had made his recent leave a misery. He was never sick, but habitually constipated.

In the forenoon of March 7, 1941, he was seized with a sharp peri-umbilical pain radiating downwards below both rectus muscles. He went off duty in his armed trawler and that night he vomited a great quantity of brown fluid on four occasions. His bowels had been open during the morning, but from that time he passed no flatus or fæces until after his operation, neither did he vomit again at any time during his illness.

On Examination, midday, March 8, the tongue was coated and moist, the skin pale, cold, and dry. Temperature 96°, pulse 52. His belly was diffusely tender and on guard in the lower right quadrant, but it was not distended or tympanitic, and there was no visible or audible peristalsis; there was neither tumour nor tumefaction. Five hours later his temperature was 99·5° F., pulse 100, and he complained of increasing central abdominal pain.

At Operation.—An exploratory laparotomy was made under ether anæsthesia. A quantity of clear non-odorous fluid welled from the laparotomy wound and coils of very distended intestine billowed out. The cæcum was sought in vain in the right iliac fossa, and the only loop of large bowel to be found was a loop of collapsed pelvic colon. The ileum was traced along, and becoming more and more distended, it vanished at the base of the mesojejunum. It was followed backwards and it did the same thing hard by its nether end, though here it was far less distended and suffused. And now appeared the distal four inches of the transverse colon, collapsed and taut, passing to the splenic flexure from this engulfing area of the mesenteric root. So it became apparent that the less distended small-gut termination was the duodeno-jejunal flexure, and that the distended end was on its way to the proximal colon imprisoned in a particularly fine example of Waldeyer's fossa. Moreover, this cavern, bulging the mesentery across the right half of the cœlom, contained an unknown length of ileum, cæcum and appendix, ascending colon, and most of the transverse colon.

The hernia was reduced with great difficulty; the entering gut was fairly bursting and the neck of the sac contained the superior mesenteric vascular network. Reduction was effected by digital dilatation of the neck, taxis on the sac, and traction on the emerging colon. The intestines, blown up and purple, were not adherent, and they soon regained a healthy hue while the contents raced to the lower reaches of the colon in a most satisfactory manner.

The new dispositions of the alimentary tract were interesting. The stomach swung down from the left costal area; the cæcum, adult in form, lay beneath the ninth costal tip, and the recently herniated terminal twelve inches of the ileum passed up to it. The hepatic flexure was unformed, the cæcum passing imperceptibly into the transverse colon towards the splenic flexure. The cæcum swung on a broad, finely vascular mesentery continuous with transverse mesocolon and meso-ileum; but the great omentum was poorly developed, fat-free, and filmy. No attempt was made to obliterate the hernial orifice because it was necessary to be covetous of time, and the neck of the sac collapsed when its grip on the bowel was released.

The patient's return to health was uneventful. Gales of wind were released on the second day of his convalescence and he passed a stool on the fourth day. He returned to his ship on May 1.

DISCUSSION

In the enchanted ground of the belly retroperitoneal hernia is a rare formation, mysterious in its origins, difficult to diagnose, and malign in its progress. Although the right and left paraduodenal fossæ account for only 2 per cent of

the intraperitoneal recesses, they give rise to the vast majority of internal herniæ. Since Treitz[2] associated these peritoneal crypts with herniation in 1857 the disorder has been periodically reviewed and his teaching has been generally accepted (Moynihan, 1899[3]; Nagel, 1923[4]; Rendle Short, 1925[5]; Dowdle, 1932[6]).

In 1923 Andrews made four observations to support the idea of a congenital development of internal hernia. They may bear repetition from a discourse on this subject by Milroy Paul and Osman Hill.[7]

1. There is no *vis a tergo* to force contents into the sac of a duodenal hernia. Differential pressures are utterly lacking in the abdomen.

2. There are literally hundreds of folds and fossæ in the peritoneal sac of large size, and they are never the sites of hernia.

3. In all but a very small minority of cases reported, the degree of herniation has been total or subtotal.

4. The herniated viscera are never anything but small intestine. Omentum, a viscus found in nine cases out of ten in other sites, has never been reported entering the sac. Pybus reports a case with a few inches of descending colon in the sac.

In the light of these assertions he understands that duodenal hernia is a congenital anomaly due to imprisonment of the small intestine beneath the mesentery of the developing colon. Brown[8] points out that this mechanism of formation of development is illogical, since the lateral position of the fixed colon precludes this catastrophe; and here is a case record of right paraduodenal herniation which refutes his third and fourth propositions and disallows his hypothesis of formation since large bowel was the principal viscus in the anchorage.

Milroy Paul and Osman Hill accept his postulates and interpret them in this manner: They observe that only the recesses of Landzert and Waldeyer of all the peritoneal crypts and crannies have the stems of great vessels related to their orifices and that these vessels pass to highly mobile lengths of intestine. They picture the sac being opened from time to time as the bowel swings on its vascular pedicle, a loop of small gut slipping into the cavity and the final incarceration of the whole small gut. This hypothesis must assume a post-natal formation; it is not likely that fœtal bowel movements could open up these cavities, or that fœtal peristalsis could haul the whole of the small intestine inside the sac, and dilate it to the considerable requirements of these enormous herniæ.

The present case suggests that the hernia may be formed before birth. It is remarkable that the imprisoned bowel was precisely the post-arterial territory of the mid-gut in an intermediate state of fixation. The clinical history dates back to childhood, and this itself is commonly reported in the records of these patients. Cases have been reported in infants, and a very fair proportion, owning no clinical history, have been discovered at post-mortem examination, suggesting that the derangement of bowel may be present from birth, and is compatible with the changing diet and activities of the early years.

The acute phase presented no distinctive signs beyond those of an 'acute abdomen', and indeed, this is the rule in these rare disorders; though Rendle Short describes a limited, resonant, gurgling tumour verying in size as the symptoms alter, with signs of recurrent strangulation or duodenal ileus.

At operation, the morbid anatomy was confusing and obscured by mutinous bowel; the absence of large gut where it might be expected, and the mysterious termination of the small bowel were interpreted by the latter end of the transverse colon. Francis R. Brown states that strangulation is rare and reduction easy. In the present instance vascular changes were all but irreversible and reduction was difficult.

Two calamities may befall this man—a recurrence and a volvulus. Short reopened a case of paraduodenal herniation, intent on repairing it, only to find it sealed off by adhesions. Handfield-Jones allowed a similar case to return to his duty with a warning.

The man in question prefers the perils of the narrow seas, and truly, fortune favours the brave.

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[6] DOWDLE, E., *Surg. Gynecol. and Obst.*, 1932, **54**, 246.
[7] PAUL, MILROY, and HILL, OSMAN, *Brit. Jour. Surg.*, 1938, Jan., 496.
[8] BROWN, F. R., *Ibid.*, 1925, **13**, 367.

REVIEWS AND NOTICES OF BOOKS

Surgical Diseases of the Spinal Cord, Membranes, and Nerve Roots. Symptoms, Diagnosis, and Treatment. By CHARLES A. ELSBERG, M.D., Emeritus Professor of Neurological Surgery, College of Physicians and Surgeons, Columbia University; etc. With Chapters by CORNELIUS G. DYKE, M.D., Associate Professor of Radiology, College of Physicians and Surgeons, Columbia University: etc.; and ABNER WOLF, M.D., Assistant Professor of Neuropathology, College of Physicians and Surgeons, Columbia University; etc. 10 × 7 in. Pp. 598 + viii, with 249 illustrations. 1941. New York: Paul B. Hoeber, Inc. $14.00.

THE surgical world will warmly welcome this book of Dr. Elsberg, which represents the summary and continuation of his previous works on *Diseases of the Spinal Cord* (1916) and *Tumours of the Spinal Cord* (1925).

The majority of the cases studied and described are from records of the Neurological Institute of New York, during the past thirty years. In two matters the author has been assisted by specialists in his own department: Dr. Cornelius G. Dyke has dealt with the progress of radiology in the diagnosis of spinal disease; and Dr. Abner Wolf has dealt with the pathology of the subject and especially that relating to tumours of the spinal cord.

Both these chapters are so well and profusely illustrated as to form most useful monographs for reference on these matters.

The book opens with a short chapter on the anatomy and physiology of the spinal cord. This deals chiefly with the relation of the spinal segments to the vertebræ and to the arrangement of the nerve-tracts. In discussing lumbar puncture consideration is given to manometric pressure, and a discussion of how this is affected by jugular pressure and by the inhalation of amyl nitrite.

The chapter on X-ray diagnosis is a remarkable demonstration of how careful expert knowledge will enable the observer to detect and interpret slight changes in the spinal column, which are associated with spinal cord disease. There are not only the gross obstructions of the spinal canal revealed by lipiodol and gas radiography, but also the slight changes in the pedicle, laminæ, and bodies, produced by the growth of intra- and extra-medullary tumours.

The chapters on injuries of the spine and cord contain detailed description of the results of injury at different levels. In regard to treatment, the preliminary handling of the patients is described without any reference to the modern idea of keeping the patient on his face. A very conservative attitude is adopted towards the possibilities of the treatment of spinal injury by operation.

A most important subject of the book is that dealing with the tumours of the cord with its full description of the pathology and histology of these growths (273 pages).

The illustrations are very clear and good, especially those describing the gross and minute structure of tumours, but *Fig.* 28 is upside down and *Fig.* 88 is so confused as to be unintelligible. There are concluding chapters on diseases of the vertebræ, abnormalities of the spinal blood-vessels, and the technique of laminectomy.

The book, representing as it does the life labour of a man who has devoted himself to this speciality, will naturally assume an authoritative place in the literature of the subject.

A Short Text Book of Surgery. By C. F. W. ILLINGWORTH, M.D., Ch.M., F.R.C.S. Edin., Regius Professor of Surgery in the University of Glasgow. Third edition. 9½ × 5¾ in. Pp. 692, with 213 illustrations, including 12 plates. 1941. London: J. & A. Churchill. 27s. net.

THE task of anyone who sets out to write a short but inclusive text-book of surgery becomes more difficult with every decade. The modern advances, especially in pathology and in all the various methods of clinical examination, have to be mentioned for the sake of completeness, but it is not possible to describe them sufficiently for the reader to gain a working knowledge of their details. The examination of the brain is a good example of this. Not only have five different kinds of tumours to be described, but a description has to be given of stereoscopic radiography, encephalography, ventriculography, and cerebral angiography.

Professor Illingworth has gone a long way towards solving this difficulty by writing a book which is crammed with information but at the same time clear and readable. The new edition contains revised statements on various matters relating to wound treatment, burns, shock, gas gangrene, blood transfusion, sciatica, varicose ulcer, pancreatitis, and facio-maxillary injuries.

The illustrations include many radiographs, and are well produced. We cannot quite reconcile ourselves to the omission of a description of the treatment of syphilis, which the author explains is now outside the province of the surgeon.

The Injured Back and Its Treatment. Edited by JOHN D. ELLIS, M.D. Contributing authors: H. EARLE CONWELL, M.D.; LOYAL DAVIS, M.D.; NATHAN S. DAVIS, M.D.; JOHN D. ELLIS, M.D.; RALPH K. GHORMLEY, M.D.; HALE A. HAVEN, M.D.; Professor Sir ARTHUR KEITH, F.R.C.S., F.R.S.; ROBERT B. OSGOOD, M.D. 9⅞ × 6½ in. Pp. 377 + viii, with 157 illustrations. 1941. London: Baillière, Tindall & Cox. 30s. net.

IT is very remarkable what a prominent place injuries of the back have assumed in the recent orthopædic literature.

This is no doubt due to the greater precision and diagnosis afforded by the X rays and also to the demands of the Workman's Compensation Act. It is a noteworthy illustration of the complexity which the subject has assumed in recent years, that it requires

no less than eight distinguished authors to do justice to the subject. We welcome the introductory chapter, by Sir Arthur Keith, who has of recent years given so much attention to the problems of orthopædics. He deals with the evolution of man's posture and the changes which have been brought about by his erect position.

Loyal Davis contributes a chapter which is chiefly of theoretical and physiological interest. He discusses backache as a symptom of visceral disease. He explains the occurrence of reflex pain and the paths of this pain in the sympathetic and spinal nerves. The practical problem of the routine examination of the injured back is by John Ellis, who describes the various active and passive movements and manipulations in their effect upon local pain. The effect of local anæsthesia upon back pain is described and discussed. Lesions of the sacro-iliac and lumbosacral regions are considered here as well as in a later chapter. The consideration of compressed fractures, without cord injury, is by Earle Conwell, who also describes the various modes of treatment by plaster cases and various modifications of Bradford's frame. It is curious that in this otherwise complete article there is no mention of mechanical methods by which the injured patients can be turned into the prone position.

The neurosurgical aspects of injuries to the back are discussed by Loyal Davis and Hale Haven, with particular attention to the indications for laminectomy.

The most important locality where back pain originates is that round the lumbosacral and sacro-iliac joints. This is dealt with by Ralph Ghormley, who lays great stress on the evidence given by hypertrophic arthritis of the morbid strains to which the articular facets are subjected. The damage done to the back by faulty body mechanics and posture is described by Robert Osgood. The concluding chapters of the book are by the Editor and are concerned with the effect of trauma in producing or aggravating inflammatory and degenerative disease: and also the minor injuries of the back, included under the term 'sprain'. Each chapter is followed by a long list of references, which helps to make the book a valuable one for reference.

In matters of theory and practice, diagnosis, and treatment the book will achieve a high place as an authority.

Surgery of the Heart. By E. S. J. KING, M.D., M.S., D.Sc. (Melb.), F.R.C.S. (Eng.), F.R.A.C.S., Major A.A.M.C., Honorary Surgeon to Outpatients, Royal Melbourne Hospital; etc. 9⅛ × 5⅝ in. Pp. 728 + xii, with 268 illustrations. 1941. London: Edward Arnold & Co. 50s. net.

THIS book is a large, almost encyclopædic, compilation on all aspects of diseases of the heart; it covers their history, anatomy, physiology, pathology, medicine, and surgery. Even taking surgery in its broadest sense the amount of space devoted to the ancillary portions is disproportionately large, and it is found that in spite of the size of the volume, which contains over 700 pages, a disappointingly small amount is devoted to the actual surgery of the heart; in fact, that portion would by itself make but a slender volume. A prominent and notable feature is the bibliography, the appropriate references being placed at the end of each section or sub-section. Its size may be appreciated when it is stated that it covers 160 pages and contains about 4,000 separate references.

Valuable as these are, their very profusion engenders a sense of bewilderment as the reader is largely left to make his own choice on the value of most of them. At times the bibliography would appear to be done to excess; for instance, it is surprising in a volume of the surgery of the heart to find 6 pages describing secondary deposits in the myocardium followed by a bibliography of 52 references covering 2 pages. In the chapter on radiography in examination of the heart we are told, somewhat unnecessarily, that "Radioscopy (Rœntgenoscopy, Fluoroscopy) is the simple application of the original observation, i.e., that the interposition of an object between a source of X rays and a screen of barium platinocyanide will give a shadow on the screen the nature of which will depend on the degree of penetrability of the various parts of the object by X rays". This chapter of 7½ pages of reading matter and illustrations is followed by 2 pages of references, the first of which is to Roentgen's original paper—surely a redundancy in a book of this type, which makes for suspicions of the pertinency of much of the rest of the large bibliography.

Judged as a summary and analysis of extant views on diseases of the heart, this book can well be recommended, but as a text-book on the surgery of the heart it is lacking in anything authoritative. Even bearing in mind that but few surgeons have had more than a small experience in cardiac surgery, one is struck by the almost complete absence of accounts of any personal experiences apart from vague generalizations. An analysis of the writer's experience of 97 cases of hæmopericardium is given on p. 548, and on p. 591 14 cases of tuberculous pericarditis are discussed, but nowhere else is there any reference to, or analysis of, his operations or their results. The whole presentation of the major problem of the surgical treatment of coronary occlusion is relatively sketchy and lacking in that exactness of description and detail that one would expect; even the author's own method of producing a new blood-supply by the use of bone-dust is mentioned almost casually, and although a coloured drawing of a specimen six months after operation is shown, no case-history is given, there is no mention of the number of times the bone-dust has been used in man and of the results obtained, nor is there any reference to a paper on the subject by the author. The whole consideration of the results of the different operations for producing a new blood-supply to the heart is contained in ten lines and consists of generalization.

By far the best parts of this book are the portions devoted to diseases of the pericardium; the section on tuberculosis of the pericardium is interesting and complete; that on constrictive pericarditis and mediastino-pericarditis is a valuable and up-to-date presentation of a difficult subject. No one interested in the problems presented by these conditions should omit to read the clear and excellent account that is contained here.

Surgical Nursing and After-Treatment. A Handbook for Nurses and others. By H. C. RUTHERFORD DARLING, M.D., M.S. (Lond.), F.R.C.S. (Eng.), F.R.F.P.S. (Glasgow), Surgeon, Prince Henry Hospital, and New South Wales Masonic Hospital, Sydney, N.S.W. Seventh edition. 7⅛ × 4¾ in. Pp. 726 + x, with 207 illustrations. 1941. London: J. & A. Churchill Ltd. 10s. 6d. net.

THIS little book, which has reached its twenty-ninth thousand and has seen seven editions since 1917, scarcely needs any recommendation, since it has evidently been much appreciated by the students and nurses for whom it was written. It will always prove useful as a book of reference for those doing ward work and attending lectures. It is much more than a text-book of nursing, as it includes a short account of the principles of physiology and pathology upon which medical science is founded. We are glad to see that a reference is made to the turn-over bed which gives such invaluable help in nursing cases of injury and disease of the spine. It is, of course, inevitable that many devices should be described, such as the Carrell Dakin method of wound irrigation, which are now seldom used. The description of blood transfusion needs to be brought more up to date. We congratulate the author in having compressed into a relatively small space a great deal of useful information.

BOOK NOTICES

[*The Editorial Committee acknowledge with thanks the receipt of the following volumes. A selection will be made from these for review, precedence being given to new books and to those having the greatest interest for our readers.*]

Cancer of the Face and Mouth. Diagnosis, Treatment, Surgical Repair. By VILRAY P. BLAIR, M.D., SHERWOOD MOORE, M.D., and LOUIS T. BYARS, M.D., of St. Louis. 10 × 6¾ in. Pp. 599, with 260 illustrations and 64 plates. 1941. London: Henry Kimpton. 50s. net.

Architectural Principles in Arthrodesis. By H. A. BRITTAIN, M.A., M.Ch., F.R.C.S., Senior Orthopædic Surgeon, Norfolk and Norwich Hospital and Jenny Lind Hospital for Children; Hunterian Professor, Royal College of Surgeons, England, 1940–41, etc. With a Foreword by HARRY PLATT, M.D., M.S., F.R.C.S. (Hon.), Professor of Orthopædic Surgery, University of Manchester; Honorary Orthopædic Surgeon, Manchester Royal Infirmary; etc. 10¾ × 8¾ in. Pp. 132 + xii, with 144 illustrations, a number in colour. 1942. Edinburgh: E. & S. Livingstone. 21s. net.

Operative Surgery. Including Anæsthesia, Pre- and Postoperative Treatment, Principles of Surgical Technic, Blood Transfusion, and Abdominal Surgery. Edited by FREDERIC W. BANCROFT, A.B., M.D., F.A.C.S., Associate Clinical Professor of Surgery, Columbia University, etc. 9⅝ × 6½ in. Pp. 1102 + xx, with numerous illustrations. 1941. London and New York: D. Appleton-Century Co. 55s. net.